JOURNAL OF ATHLETIC TRAINING

VOLUME 34 • NUMBER 1 • JANUARY–MARCH 1999

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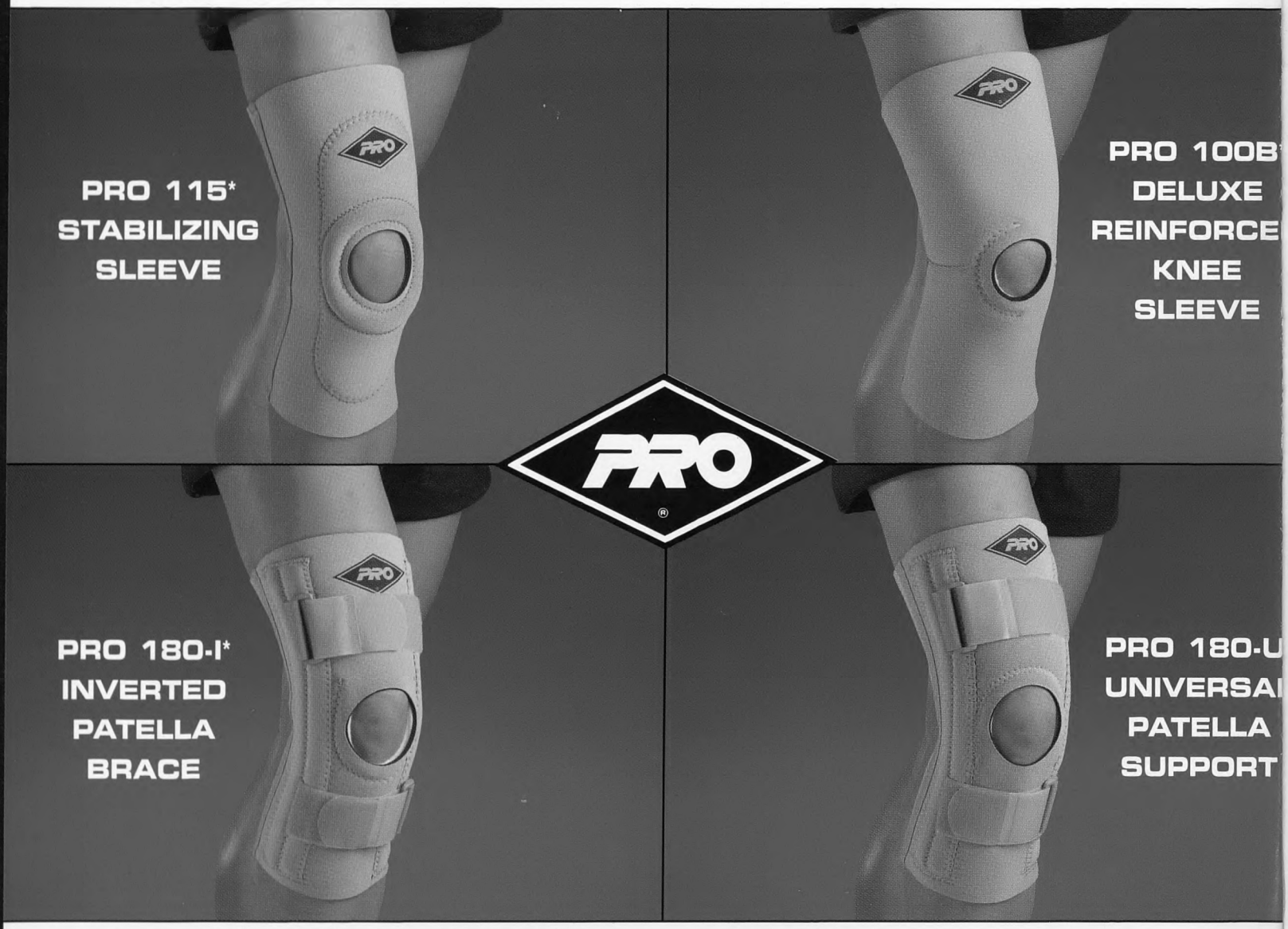

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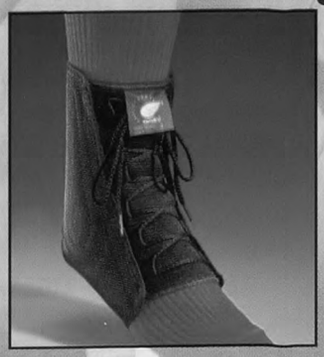

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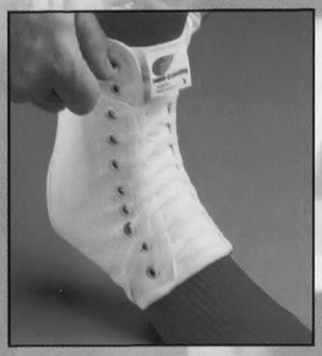

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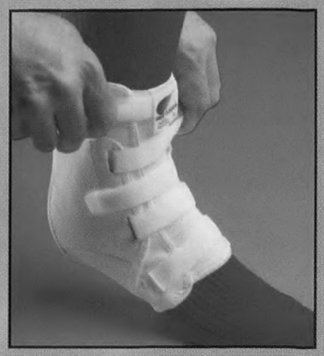

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Original Research

Case Reports

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N A T A
RESEARCH & EDUCATION FOUNDATION

REQUEST FOR PROPOSALS

Introduction

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

Background

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

It is assumed that exercise and sports participation have positive effects on children, and increasing evidence shows regular exercise is important to their physical and psychological well-being. Yet, participation in sport does pose risks. Increasing sports specialization at younger and younger ages has placed a high premium for athletic success. However, little is known about the incidence and severity of injuries associated with child or adolescent participation in these activities. Therefore, a great need exists for epidemiological studies to determine pediatric injury patterns and specific populations at risk. Furthermore, types of intervention strategies to reduce the incidence and severity of pediatric injuries in sport need to be developed as well as the measures of their effectiveness.

Objectives

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

Procedure

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

NATA Research and Education Foundation
2952 Stemmons
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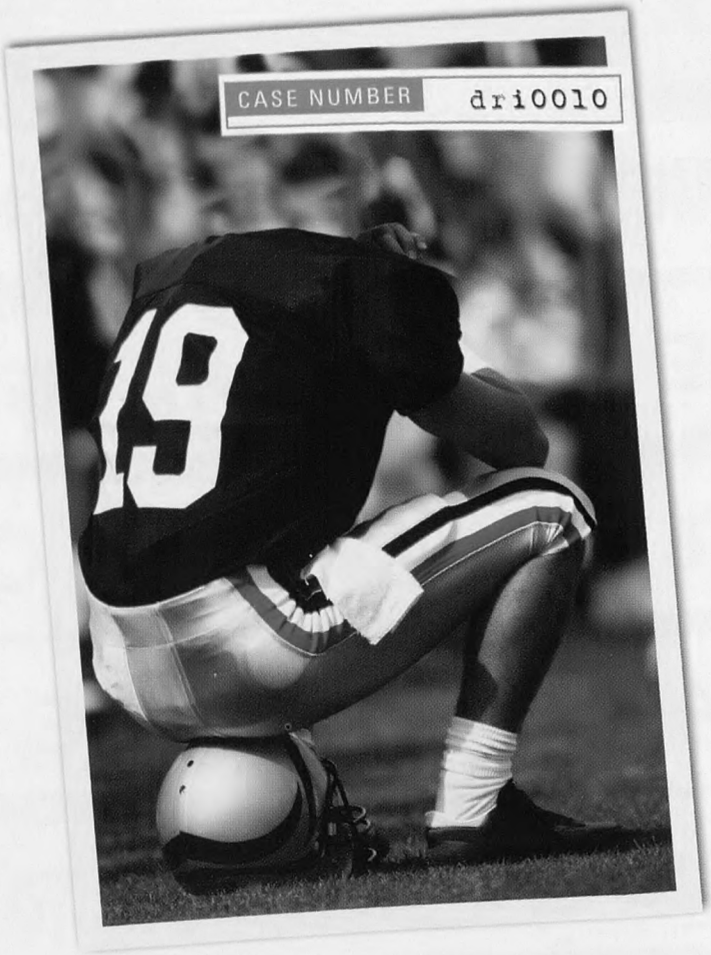

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CAN'T FIND THE CEU QUIZ?

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The CEU Quiz, formerly placed in the *Journal of Athletic Training*, now appears in the *NATA News*, a monthly magazine for NATA members. The quiz schedule for 1999 is:

Articles in *Journal*	Quiz in *NATA News*
March (Vol. 34, No. 1)	April 1999
June (Vol. 34, No. 2)	June 1999
September (Vol. 34, No. 3)	October 1999
December (Vol. 34, No. 4)	January 2000

The CEU Quiz also is posted on the NATA Fax-on-Demand Service. Access the quiz by dialing toll-free (888) ASK-NATA or 214-353-6130 from a touch-tone telephone. Follow the automated instructions, requesting Document #1112. Deadlines for submitting each quiz are posted in the *NATA News*.

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■ 22nd Annual NATA Student Writing Contest ■

In an effort to promote scholarship among young athletic trainers, the National Athletic Trainers' Association, Inc sponsors an annual writing contest.

1. The contest is open to all undergraduate members of the NATA.
2. Papers (eg, original research articles, literature reviews, case reports, or clinical techniques articles) must be on topics germane to the profession of athletic training.
3. Entries must neither have been published by, nor be under consideration for publication by, any journal.
4. The winning entrant will receive a cash award and recognition as the winner of the Annual NATA Student Writing Contest. The winning paper will follow the normal process of submission and review for possible publication in the *Journal of Athletic Training*. One or more other entries may be given honorable mention.
5. Entries must conform to the *Journal's* Authors' Guide, which provides the most current information on format and style. For advice about writing, we suggest that authors consult Kenneth L. Knight and Christopher D. Ingersoll's "Structure of a Scholarly Manuscript: 66 Tips for What Goes Where" (*J Athl Train.* 1996;31:201–206) and "Optimizing Scholarly Communications: 30 Tips for Writing Clearly" (*J Athl Train.* 1996;31:209–213).
6. Entries must be received by March 1, 2000. The winner will be announced at the Annual Meeting and Clinical Symposia in June.
7. The Writing Contest Committee reserves the right to make no awards if, in its opinion, none of the entries is of sufficient quality to merit recognition.
8. An original and 2 copies of each entry must be received at the following address by March 1, 2000:

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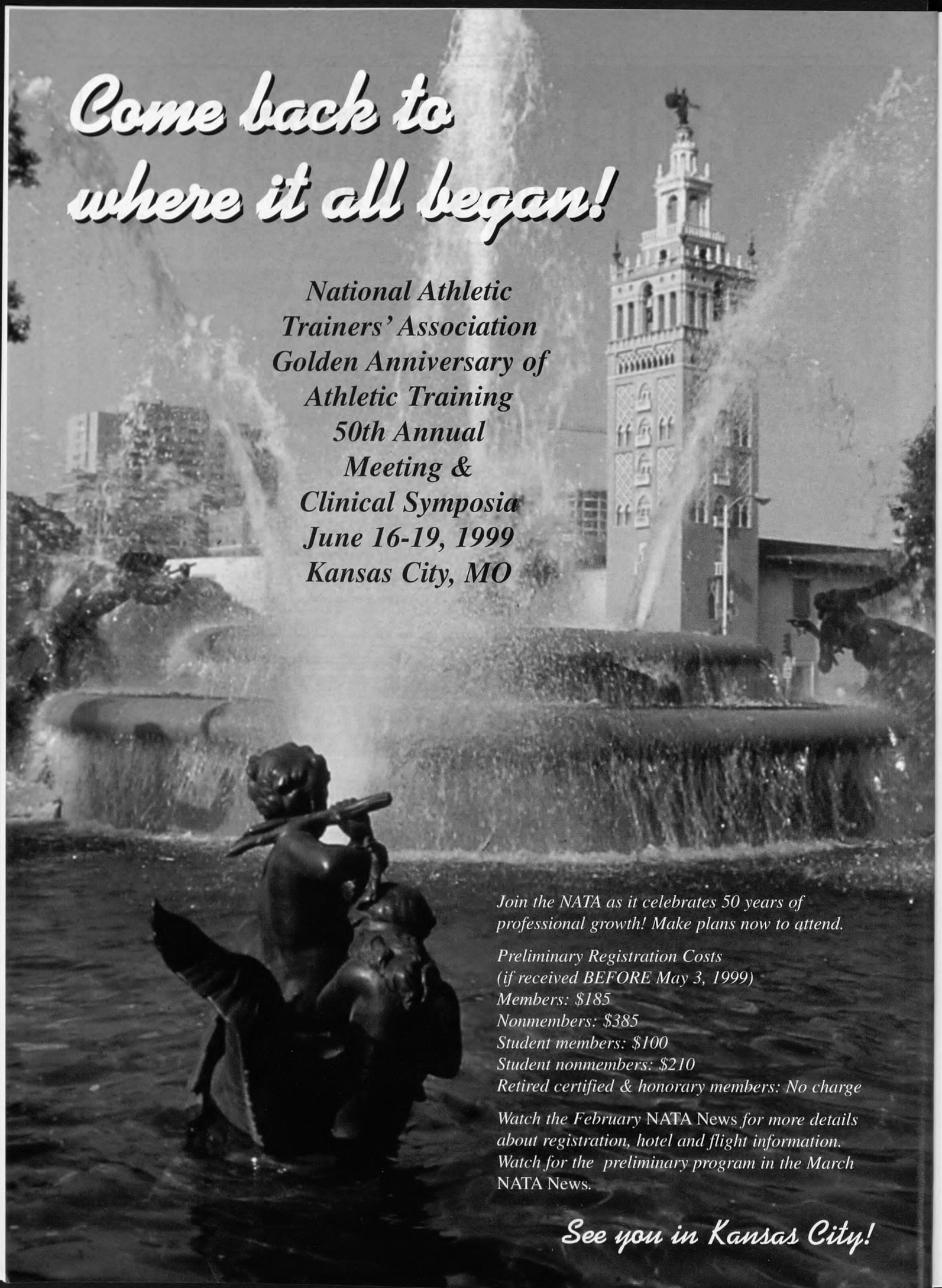
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Watch the February NATA News for more details about registration, hotel and flight information. Watch for the preliminary program in the March NATA News.
See you in Kansas City!

Editorial

The Golden Anniversary of Athletic Training

David H. Perrin, PhD, ATC
Editor-in-Chief

This year—1999—is the 50th-year anniversary of the National Athletic Trainers' Association. Founded in 1950, our association has grown to a current membership of approximately 25 600, which includes 18 266 certified athletic trainers, 4518 students, 1161 associate members, and 101 honorary members. The first annual meeting of the NATA in Kansas City was attended by 258 people, including 101 athletic trainers. The 1998 Annual Meeting and Clinical Symposia of the NATA in Baltimore was attended by 9376 people. Of these, 5843 were certified athletic trainers.

The growth of our profession has been quite remarkable, both in numbers and in sophistication, as we have worked to establish ourselves as major players in the delivery of health care to physically active people. The father of modern-day athletic training, William "Pinky" Newell, saw the need for certification and education and provided the impetus for visionaries like Sayers "Bud" Miller and Lindsy McLean to develop programs in each area. In 1970, the first certification examination was administered to 14 candidates in Waco, Texas, and in 1969 the first 4 educational programs were approved by the NATA. The certification examination is now administered 5 times per year at 62 locations, and approximately 100 academic programs in athletic training are accredited at the undergraduate or graduate level in colleges and universities throughout the country. More recent noteworthy contributions to the evolution of our profession have been the establishment of the Research and Education Foundation in 1991 and the Education Council in 1997. The charge of the Foundation is to foster and fund scholarship in athletic training. The Education Council oversees virtually every component of education for the athletic trainer, including entry-level and advanced graduate education, continuing education, and competencies and clinical education in athletic training.

In this 50th year of the NATA, the *Journal of Athletic Training* enters its 34th year of publication. Initially known as *The Journal of the National Athletic Trainers' Association*, then *Athletic Training, JNATA*, and now the *Journal of Athletic Training*, our scholarly publication is currently read by 26 500 subscribers in the United States and 38 foreign countries. The *Journal of Athletic Training* is pleased to participate in the golden anniversary celebration of the National Athletic Trainers' Association. To this end, you will note the 50th-year insignia on the cover of each issue of Volume 34 of *JAT*. In this volume, we will also publish 50th-year commemorative articles dealing with topics such as the history of education and certification. In this issue, you will find an article on the history of athletic training education, written by 2 former chairmen of the NATA Professional Education Committee and the Joint Review Committee of the Commission on Accreditation of Allied Health Education Programs. As a companion to this article, we are reprinting a 1970 article by Sayers "Bud" Miller calling for the establishment and approval of athletic training education programs in our profession.

We have also witnessed over the past 50 years remarkable improvements in techniques to treat injuries to physically active people. Yet some solutions still elude us. Perhaps no more prominent is the dilemma of injury to the anterior cruciate ligament in the female athlete. As part of this 50th-year celebration of our profession, an upcoming *JAT* issue—our first special issue—will be devoted to anterior cruciate ligament injuries in the female athlete.

I hope you will enjoy the commemorative articles written by past and present leaders of our professional organization and the special issue on ACL injuries. This, the golden anniversary of athletic training, is a time for each member of the National Athletic Trainers' Association to pause for several reasons: to remember our founding and visionary leaders; to share in the pride of our remarkable growth; and to make a commitment to actively participate in the continued evolution of our profession into the next millennium.

Letters to the Editor

Everything to Everyone?

Recently I've been thinking about where our profession is going and just what the expectations of the modern ATC working in the "traditional" college/university setting are. I've talked to other ATCs around the country, as well as other allied health care professionals.

People have suggested that, because of the potential for having to deal with emergency situations, ATCs should become certified EMTs or that athletic training curriculums should at least increase the amount of time devoted to emergency situation skill development. Still others have suggested that a counseling and guidance credential is needed in order to deal successfully with some of the emotional issues that athletes bring to the ATC. Our own Education Council proposes that only "approved clinical instructors" (ACIs) supervise clinical education in CAAHEP-approved athletic training programs. Many ATCs are already carrying heavy administrative loads with the necessary record-keeping, budget, and insurance tasks inherent in many positions. Time demands on the collegiate athletic trainer have increased with the recent NCAA recommendations for medical coverage of all nontraditional season athletic activities and skill sessions. Combine this with the expectation of teaching excellence, advising, and scholarship that is inherent in many college/university positions, and you have an unrealistic expectation of what a single individual can hope to do with any degree of excellence.

I'm concerned that we are trying to be all things to all people and that, if we continue down that path, we are going to spread ourselves so thin that we won't be very good at anything. I think any discussions in this area should begin with our taking a critical look at what we're not. Administrators, coaches, and athletes need to understand that we are athletic trainers, not physicians, physical therapists, paramedics, meteorologists, pharmacologists, ergonomics experts, or counselors. Our profession does encompass some knowledge and skills from many of these areas, but not all of the knowledge and skills from all areas. While our profession has fought long and hard for its due recognition, I think that some people we deal with, perhaps because it is financially prudent for them, give us too much credit. In other words, they see us as having the same expertise as a credentialed professional in each of these areas. While this recognition is gratifying, it can also be dangerous. Administrators should not be satisfied with having an ATC present at a large wrestling or hockey tournament, for example, when what might really be appropriate is a physician and/or ambulance along with an ATC. Athletic trainers have considerable knowledge and skills that overlap many different areas of expertise, and we should be justifiably proud of that. However, to paraphrase a longstanding bit of wisdom, it's a wise sportsmedicine professional who knows his limitations.

It's my belief that this is the start of a period of extensive change in the profession of athletic training. I foresee 2 changes as inevitable. The first is the elimination of the traditional college/university ATC in a CAAHEP-approved undergraduate athletic training education program. Very soon it is going to simply be impossible for any individual to satisfy all the demands of that job as we know it. Teaching, producing scholarship, advising, performing service such as department and school committee work, and functioning as both a clinical supervisor and clinical athletic trainer are too much for one person to do with any degree of success. CAAHEP-approved programs are going to have no choice but to follow the model Brent Mangus, EdD, ATC, suggested in a recent editorial (*J Athl Train.* 1998;33: 308–309.). In it, Dr. Mangus discussed the desirability of separating clinical practitioners of athletic training from classroom instructors, even though it is my impression that many athletic training educators find this undesirable. The educational model that has been in place for many years meant that the ATC teaching athletic training classes in the morning was the same ATC supervising student athletic trainers and providing athletic training services to athletes in the afternoon. Anything else is a radical change for most of us.

The second change I see as inevitable is the necessity for some kind of formal specialization within the profession. The time has come for us to take a serious look at different areas of specialization that an ATC might choose to pursue and the specific requirements for those particular areas of specialization. Should clinic-based ATCs have additional (beyond entry-level) competence in the area of treatment and rehabilitation because that's the domain in which they spend much of their time? What about the developing area of industrial ATCs? Is a specialization in ergonomics necessary? Should the high school and college/university ATC possess some type of additional credential in emergency care (EMT certification) because of the potential for having to deal with a life-threatening emergency while covering such traditional sports as football and lacrosse? Should the ATC who is working in a CAAHEP-approved athletic training education program possess certification as an ACI? When our current educational model was being developed by the early members of the Professional Education Committee, those members knew what an entry-level ATC would be doing because it was the same thing they did: serving as an athletic trainer for a high school, college, or professional team. With the numerous career options currently available to the ATC, no standard job description for our profession exists. As a college/university ATC in a CAAHEP-approved undergraduate program, I have more in common with high school teacher/ATCs than I do with college/university colleagues at institutions that do not sponsor athletic trainer education. My job only minimally resembles that of clinic-based ATCs. Maybe it's time to consider implementing a model that requires a BS in athletic training, followed by an MS or fellowship that

would provide specialized training for employment in a particular area, such as a clinic, a high school (perhaps combined with a teaching credential), or a college/university. In this way we would ensure that ATCs possess a certain level of general expertise, guaranteed by the certification exam, but also a specific body of knowledge required by their particular arena of employment.

Michael L. Matheny, MS, ATC
Ithaca College
Ithaca, NY 14850

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ERRATUM

Kaminski TW, Wabbersen CV, Murphy RM. Concentric versus enhanced eccentric hamstring strength training: clinical implications. *J Athl Train.* 1998;33(3):216–221.

On page 219, the incorrect figure was inserted for Figure 4. Figure 4 should have appeared as follows:

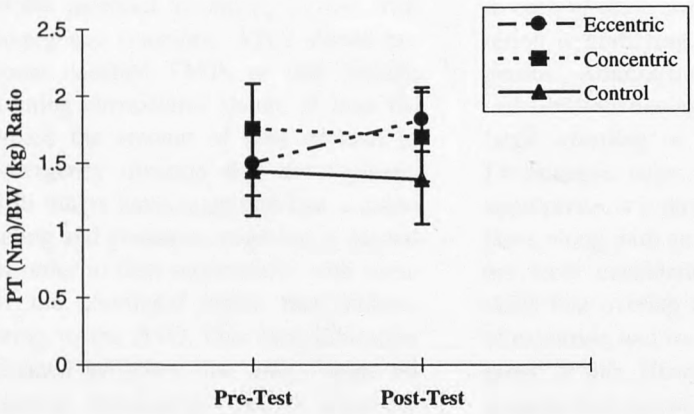

Figure 4. Graphic representation of the significant group (eccentric training, concentric training, and control)-by-test (pretest and posttest) interaction for eccentric PT/BW ratios at 180°/s.

Journal of Athletic Training 1999;34(1):5–10

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Comparison of 3 Methods of External Support for Management of Acute Lateral Ankle Sprains

Kevin M. Guskiewicz, PhD, ATC*; Bryan L. Riemann, MA, ATC†; James A. Onate, MA, ATC‡

* Sports Medicine Research Laboratory, Department of Physical Education, Exercise, and Sport Science, University of North Carolina, Chapel Hill, NC; † Department of Health, Physical, and Recreational Education, University of Pittsburgh, Pittsburgh, PA; ‡ Southeast Raleigh High School, Raleigh, NC

Objective: To examine the efficacy of 3 different types of injury support systems (standard elastic wrap with horseshoe, Aircast Sport Stirrup, and Omni Multiphase orthosis) used in treating acute inversion ankle sprains.

Subjects: We recruited 30 physically active college-aged subjects who had sustained a grade 1+ or 2 lateral ankle sprain within the previous 24 hours for the study.

Design and Setting: Subjects were randomly placed into one of 3 groups, the first treated with standard elastic wrap with horseshoe, the second with an Aircast Sport Stirrup, and the third with an Omni Multiphase orthosis. Subjects reported to the athletic training room on days 1, 2, 3, 5, and 7 postinjury.

Measurements: We assessed subjects for ankle volume, functional performance, and self-perception of symptoms during the 5 postinjury assessments.

Results: We found no significant differences among the 3 groups on measures of volume, level of function, and self-perception of symptoms.

Conclusions: Our results suggest that none of these methods is superior to the others for reducing swelling, restoring function, or relieving symptoms during the acute management of lateral ankle sprains.

Key Words: focal compression, edema reduction, ankle stirrup

Edema about the ankle is a naturally occurring phenomenon associated with inversion ankle sprains. While inversion ankle sprains are one of the most frequently occurring injuries among athletes and physically active people, the optimal method of treatment still remains controversial. Various treatment plans for the management of acute ankle injuries have been proposed and are well documented in the literature.[1–6] Most clinicians will agree that functional treatment protocols should involve cryotherapy, elevation, compression, protection, and nonsteroidal anti-inflammatory medications to control pain and inflammation. There is debate, however, as to which method of external compression and support is best for reducing edema and promoting recovery for an early return to activity.

Until recent advancements made available rigid external support systems offering both stability and focal compression, clinicians used an elastic wrap for circumferential compression, an elastic wrap with a horseshoe pad for focal compression, or a rigid stirrup brace offering both stability and collateral compression. Circumferential compression produces a consistent pressure around the entire circumference of a limb. It has been described as being most effective in reducing swelling around regularly shaped contours, such as the leg or thigh, especially when applied in a graduated manner.[7,8] In contrast, focal compression with a horseshoe-shaped pad is best applied in areas where concavities about bony prominences exist. This technique, when combined with circumferential compression, theoretically promotes lymph drainage by diverting edema in a proximal direction through soft tissue compression under the pad.[8,9] Ankle stirrup braces are believed to offer the medial and lateral joint stability necessary for early ambulation, while providing increased collateral pressures for promoting removal of edema. It is believed that these orthoses provide variable collateral compression of the extremity as soft tissues are compacted between the compressive device and underlying bone during ambulation.[10]

Debate exists as to whether or not the added cost of the manufactured support systems meets the expected cost:benefit ratio in comparison with the standard treatment method involving an elastic wrap and horseshoe. Our purpose, therefore, was to determine whether one method of external support for acute ankle sprain management was superior in reducing swelling, restoring function, or relieving subjective symptoms.

Address correspondence to Kevin M. Guskiewicz, PhD, ATC, Sports Medicine Research Laboratory, CB No. 8700, University of North Carolina, Chapel Hill, NC 27599-8700. E-mail address: gus@email.unc.edu

METHODS

Procedures

Thirty subjects who had sustained acute lateral ankle sprains participated in this study. Qualifying ankle sprains involved suspected stretching or partial tears to the anterior talofibular ligament (grade 1+ or 2). All sprains exhibited mild to moderate instability with an anterior drawer test, moderate point tenderness over the anterior talofibular, calcaneofibular, or anterior tibiofibular ligaments, a sudden onset of edema, and no history of an ankle sprain within the previous 6 months. All prospective subjects were evaluated by one of the 3 investigators, all of whom are certified athletic trainers. The study was approved by the Academic Affairs Institutional Review Board at the University of North Carolina at Chapel Hill, and subjects reviewed and signed a human subjects informed consent form before participating.

We randomly placed subjects into one of 3 groups within 24 hours after injury, according to a predetermined rotation of the 3 support systems. Group 1 subjects (8 males and 2 females, 21.4 ± 1.5 years old, ht = 179.1 ± 9.4 cm, wt = 78.2 ± 14.2 kg) were placed in the Multiphase (Omni Scientific, Inc, Concord, CA) orthosis, which consists of a rigid plastic shell that provides ankle stabilization and inversion control (Figure 1). The unique feature of this orthosis is a built-in focal compression pad designed to facilitate translocation of edema away from the lateral ankle ligaments. Group 2 subjects (9 males and 1 female, 20.2 ± 1.2 years old, ht = 178.6 ± 7.4 cm, wt = 75.7 ± 11.5 kg) were placed in the Aircast Sport Stirrup (Aircast Inc, Summit, NJ). The Aircast Sport Stirrup consists of 2 plastic shells aligned with adjustable air bladders that support the ankle both medially and laterally (Figure 2). The bladders are designed to exert alternating pressures during the plantar flexion and dorsiflexion of locomotion. Both the Aircast and Multiphase braces were sized and applied according to the manufacturers' recommended guidelines to ensure consistent compression and support. Proper brace application was also demonstrated by one of the 3 investigators. Group 3 subjects (10 males, 21.7 ± 3.4 years, ht = 183.9 ± 6.3 cm, wt = 81.5 ± 11.5 kg) were placed in a 7.62-cm (3-inch) single-length elastic wrap and 0.64-cm (0.25-inch) felt horseshoe. A 15.24-cm (6-inch) horseshoe was custom fit to encircle the lateral malleolus and divert edema away from the soft tissue surrounding the lateral ankle ligaments. Compression was administered using a distal to proximal graduated method, whereby the pressure was greatest distally (Figure 3). The elastic wrap and horseshoe were applied by one of the 3 investigators after each treatment; however, subjects were also trained in proper self-application.

Figure 2. Aircast Sport Stirrup.

Five postinjury assessments were made on all subjects at days 1, 2, 3, 5, and 7 (same time of day ± 1 hour). In an attempt to ensure consistent procedures and results, subjects were assessed by only one of the 3 investigators. The investigators practiced and piloted the protocol before beginning the study. All subjects began a standardized rehabilitation program on day 1 postinjury, which involved a progression of range-of-motion, strengthening, and balance exercises. Subjects continued the daily program until their strength reached approximately 90% of the uninvolved extremity and they were able to perform straight-ahead jogging without pain and apprehension. All subjects wore their respective ankle support during waking

Figure 1. Omni Multiphase.

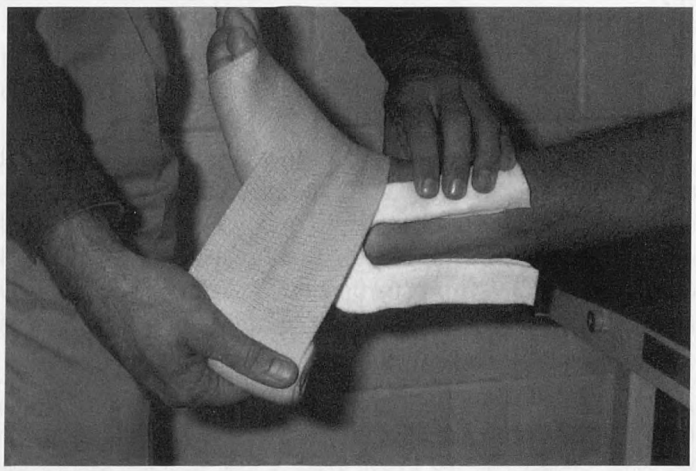

Figure 3. Elastic wrap and felt horseshoe.

hours, beginning on day 1 postinjury, and abstained from taking nonsteroidal anti-inflammatory medications or performing physical activity involving the lower extremities. A 20-minute elevation and cryotherapy (ice application using elastic compression wrap) treatment followed each rehabilitation and assessment session. Subjects were instructed to undergo 2 additional cryotherapy treatment sessions on assessment days and 3 cryotherapy treatment sessions on nonassessment days. Crutches were required for ambulation until subjects attained level 2 status on the Functional Assessment Scale (Table 1). Although this study was concerned with acute phase management of the injury, subjects were encouraged to continue rehabilitating their ankles for several days after attaining level 5 status.

Visual Analogue Scales

Subjects completed a series of visual analogue scales inquiring about levels of pain and disability (Table 2). The first 3 scales listed in Table 2 were completed on day 1 postinjury, while all 5 scales were completed on subsequent days. Subjects were asked to place a mark on each 10.5-cm scale illustrating their level of pain or disability. Higher scores were indicative of a more symptomatic self-perception.

Volumetric Measurements

Ankle volume at each testing session was determined by measuring the amount of water displaced by the ankle in a volumetric measuring tank (Figure 4). The reliability of this device was previously determined in 2 studies to be ±3.8%[11] and ±3%.[12] The procedure for using the device was identical to the methods used in a previous study,[11] whereby the subject's ankle was slowly lowered into the tank from a seated position (hip, knees, and ankles positioned at 90°) behind the tank until the foot came to rest on the bottom. The shaft of the tibia was maintained perpendicular to the base of the tank, and air bubbles were eliminated by slight movement of the submerged limb. Excess water displaced by the ankle was collected through a piece of surgical tubing and measured using a graduated cylinder in milliliters. The water temperature was between 21.1°C (70°F) and 23.9°C (75°F), and the measurement was completed in less than 3 minutes so that the limb would not be placed in a gravity-dependent position for an excessive period of time.

Table 1. Functional Assessment Scale

Level	Criteria
0	Nonweightbearing
1	Partial weightbearing or weightbearing with obvious limping, mild pain, or apprehension
2	Normal gait without pain or apprehension
3	Heel/toe raise without pain or apprehension
4	Straight-ahead jogging without pain or apprehension, strength <90%
5	Zig-zag running at 100% maximum speed without pain or apprehension, strength = 100%

Table 2. Visual Analogue Questions Used for Subjective Symptom Assessment

1. Do you experience pain when walking (or attempting to walk) without crutches?
2. Do you experience pain while sitting or lying down?
3. To what extent is your normal function impaired?
4. Did you have difficulty sleeping due to pain?
5. Were you able to walk without limping while wearing the brace?

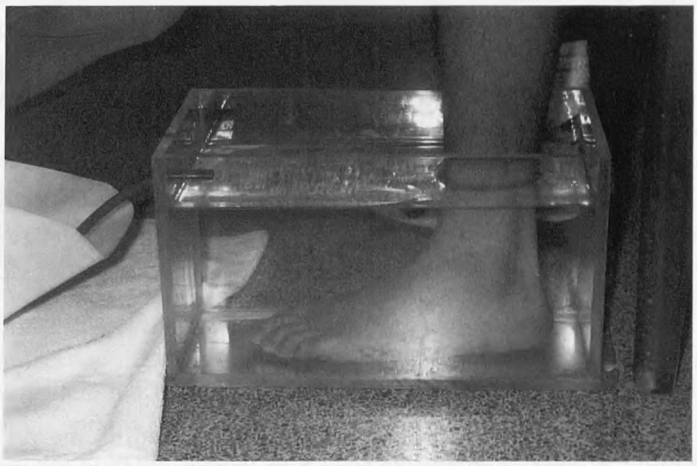

Figure 4. Volumetric measurement of ankle using water displacement method.

Functional Assessment Scale

The functional ability of subjects at each testing session was evaluated and assigned a number (0–5) using a functional assessment scale (Table 1). Subjects found to be between levels were given the lower level value, with 0.5 added. This is a modified version of the functional scale used by Wilkerson and Horn-Kingery.[13]

Statistical Analysis

Statistical analyses were performed using the SPSS statistical package (release 6.1, SPSS, Inc, Chicago, IL). Separate, repeated-measures analyses of variance (ANOVAs) for each of the dependent variables (volume, visual analogue scales, and functional assessment scale) were conducted to reveal differences between groups. An α level of $P < .05$ was set a priori.

RESULTS

The results of the separate, repeated-measures ANOVAs for each dependent variable did not reveal any significant group by day interactions ($P > .05$) (Figures 5–9). Additionally, all analyses revealed significant main effects for day ($P < .05$), suggesting that subjects had significant improvements across the testing period, regardless of the external support used. Our

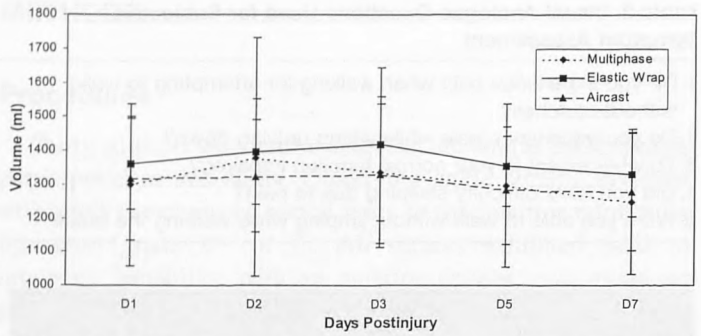

Figure 5. Ankle volume means (± SD) for each group across each testing session. The ANOVA found no significant interactions ($F_{8,108}$ = .45, P = .885).

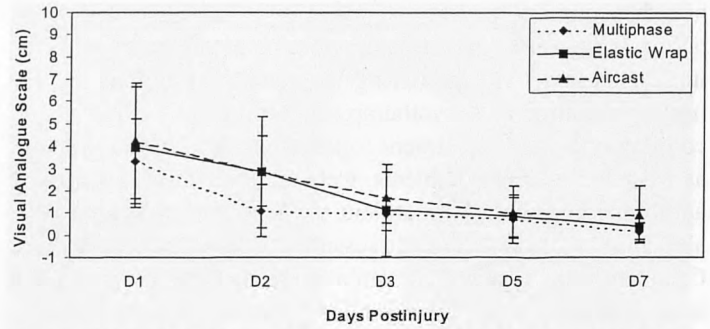

Figure 7. Visual analogue scale means (± SD) for the question, "Do you experience pain while sitting or lying down?" for each group across each testing session. Higher scores represent increased self-perception of symptoms. The ANOVA found no significant interactions ($F_{8,108}$ = .75, P = .645).

results suggest that none of the methods used was superior to the others for reducing swelling, restoring function, or relieving symptoms during the acute management of lateral ankle sprains.

DISCUSSION

Although there is little controversy surrounding the primary clinical objectives during the acute inflammatory phase after an ankle injury, there is debate as to the best method of attaining the objectives. The extent of secondary hypoxic injury can be limited by decreasing the amount of vascular blockage (compression and elevation) and decreasing the need for oxygen in the area (cryotherapy). There are several methods by which debris and toxic substances can be removed from the injured area, and it usually falls upon the athletic trainer to make a clinical judgment on which method to use.

Aside from the issue surrounding which method creates the best healing environment, there is the complication of cost effectiveness. Unfortunately, the choice of treatment is often determined by budgetary constraints. Treatment options available in emergency rooms and physical therapy clinics may differ from those available in the athletic training rooms of high schools, colleges, or professional settings. The most important finding in our study was that none of the external support systems used for treating acute lateral ankle sprains was superior for reducing swelling, restoring function, or relieving symptoms during the acute management phase.

Subjects in all 3 groups demonstrated decreases in volume after day 3 postinjury. None of the braces appeared to influence swelling any more than the others over the initial 7 days after injury. Our findings are not consistent with the reports of some authors[6,8] who suggested that focal compression is advantageous over other modes of compression. The goal of focal compression is to encourage edema to spread over a large area, aiding the lymphatic system in its removal of the edematous fluid.[9] The significant main effect for day in our study revealed that, on average, swelling was reduced at day 5; however, the absence of a significant day-by-group interaction confirmed that the 3 treatments were equal. One reason for this may be that the method used to measure volume did not differentiate specific locations of edema. Therefore, unless an external support displaced edema proximally from both the foot and ankle, we would not detect a difference through volumetric measurements. Similar results of equal swelling reductions between elastic wrap and Aircast were reported by Dettori et al.[14]

Our results involving swelling were surprising; equally so was our finding that all subjects demonstrated similar return

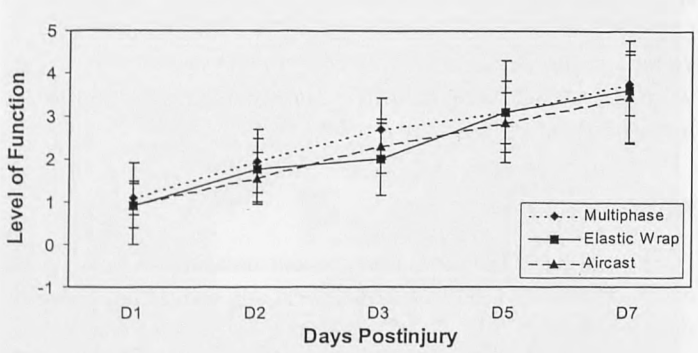

Figure 6. Functional assessment means (± SD) for each group across each testing session. The ANOVA found no significant interactions ($F_{8,108}$ = .65, P = .735).

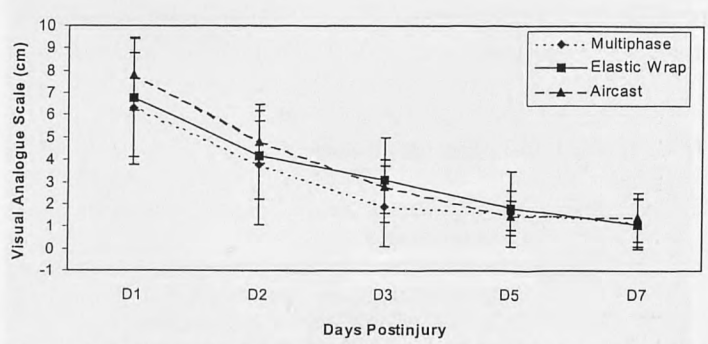

Figure 8. Visual analogue scale means (± SD) for the question, "To what extent is your normal function impaired?" for each group across each testing session. Higher scores represent increased self-perception of symptoms. The ANOVA found no significant interactions ($F_{8,108}$ = 1.34, P = .233).

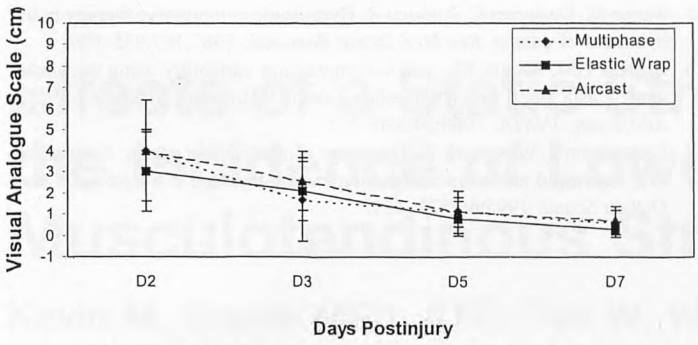

Figure 9. Visual analogue scale means (± SD) for the question, "Were you able to walk without limping while wearing the brace?" for each group across each testing session. Higher scores represent increased self-perception of symptoms. The ANOVA found no significant interactions ($F_{6,78}$ = .81, P = .564).

to function patterns (Figure 6). In other words, the rate at which the subjects progressed along the functional ability continuum was independent of the ankle support. This may be attributed to the similar edema reductions across groups, since edema has been reported to be directly related to healing,[14] pain,[5] and functional recovery.[15] The similarities in edema reduction can also be explained by the fact that perception of pain and function were similar across the 3 groups (Figures 7–9). These factors are likely to dictate a person's willingness to perform activities that could affect swelling in the injured ankle. It is interesting to note that subjects in the elastic wrap group scored the same as those subjects using the more rigid support braces when asked about their ability to walk without a limp (Figure 9).

Patient comfort and compliance are also important considerations when making decisions about which support to use. It became apparent to us when interviewing subjects before their daily treatments that all 3 braces have advantages and disadvantages. First, several subjects claimed to have had difficulties fitting the Aircast and Multiphase supports into their shoes. Some athletes also complained that these braces did not fit properly along the ankle and foot. While we believe the subjects in our study complied with the protocol, these concerns might lead to noncompliance by athletes returning to activities of daily living, sport, or both, immediately after injury. A second issue involved the ease with which each support could be self-applied. Subjects using the Aircast and Multiphase appeared to have little trouble fastening the braces with the hook-and-fastener straps, whereas several subjects assigned to the elastic wrap and horseshoe group reported some difficulty applying the elastic wrap while holding the horseshoe. Despite educating the subjects on self-application of their support systems, we suspect that the difficulty of self-application in some cases could have led to inconsistencies in both the support and compression offered by the system. Duffley and Knight[16] reported inconsistencies of compression application using similar support systems. Some subjects wearing the elastic wrap and horseshoe reported feeling less support in comparison with subjects in the other 2 groups, but, as mentioned previously, they were able to walk without a limp. As for compliance, daily contact ensured us that subjects wore their support braces for the duration of the study.

In conclusion, rising health care costs have resulted in clinicians being asked to justify their treatments with outcome studies. A limited number of studies have considered the cost effectiveness of managing ankle sprains, with only 2 actually studying methods of external support.[14,17] Our study supports the notion that an elastic wrap and horseshoe may be the most cost-effective method of external support for acute management of an inversion ankle sprain, since none of the 3 supports was shown to be superior for any of the variables measured.

We recommend that clinicians base their decision on individual needs, as well as on available resources. For example, individuals who are likely to be on their feet during the acute phase and are not likely to follow home instructions might benefit more from using either the Aircast or Multiphase. Alternatively, individuals who are more likely to comply with home instructions will do just as well with an elastic wrap and horseshoe. The bottom line, however, is that a $3.00 elastic wrap and felt horseshoe is as effective in treating acute lateral ankle sprains as a $30.00 ankle brace, regardless of whether the person is being treated in a physical therapy clinic or a high school, college, or professional athletic training room.

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Effects of a Static Stretching Program on the Incidence of Lower Extremity Musculotendinous Strains

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Objective: Musculotendinous strains are among the most prevalent injuries for which health care professionals provide treatment and rehabilitation interventions. Flexibility has been identified as one of the primary etiologic factors associated with musculotendinous strains, but limited research exists on the effect of a preventive stretching program on musculotendinous strains. Therefore, the purpose of our study was to compare the number of musculotendinous strains for the hamstrings, quadriceps, hip adductors, and gastrocnemius-soleus muscle groups before and after the incorporation of a static stretching program for each muscle group.

Design and Setting: We analyzed the incidence of musculotendinous strains among the players of a Division III collegiate football team between 1994 and 1995. All variables were consistent between the 2 seasons except for the incorporation of a lower extremity stretching program in 1995.

Subjects: One hundred and ninety-five Division III college football players.

Measurements: We calculated the number of musculotendinous strains that required a minimum absence of 1 day from practices or games in 1994 and 1995.

Results: A χ^2 analysis revealed a significant reduction in the number of lower extremity musculotendinous strains in 1995 as opposed to 1994.

Conclusions: Our statistical analysis indicates an association between the incorporation of a static stretching program and a decreased incidence of musculotendinous strains in Division III college football players.

Key Words: muscle injury, flexibility, prevention, lower extremity injury

Musculotendinous strains are among the most prevalent, as well as the most frustrating, groups of injuries for athletes and health care professionals.[1–4] In particular, hamstring injuries are the most common musculotendinous injury in the lower extremity and, accordingly, have received primary attention.[5–8] Other lower extremity muscles, especially those with complex architecture that span 2 joints, are also susceptible to strains.[9,10] As a means of aiding health care professionals in prevention and rehabilitation of hamstring injuries, Worrell and Perrin[11] proposed a theoretical model for hamstring strains, suggesting that they result from a complex interaction of 4 etiologic factors: warm-up, strength, fatigue, and flexibility. We speculate that this model is also applicable to other muscle groups. Although data exist to support the relationship between the 4 etiologic factors and musculotendinous unit susceptibility,[2,6,7,11–23] limited studies have investigated the effects of a prevention program on hamstring or other lower extremity muscle group injury susceptibility.[16]

Improved flexibility has long been considered a major component of preventive treatment of musculotendinous strains, and various studies have attempted to elucidate the relationship.[2,12,13,17,18,23] The scientific basis, however, by which stretching prevents injury has not been adequately investigated.

Creep and force relaxation are 2 physical properties of muscle tissue that influence a muscle's response to prolonged stretching. Creep is defined as the ability of muscle tissue to deform in response to a constant force.[24] Force relaxation refers to the decrease in force required to maintain muscle elongation at a given length.[24] Taylor et al[22] examined both of these concepts using the rabbit model. To examine creep, rabbit extensor digitorum longus muscles were stretched from an initial force of 1.96 N to 78.4 N and held for 30 seconds before returning to the initial force. Ten trials were performed on each muscle. Across the trials, a 3.45% increase in muscle length occurred to withstand the predetermined stretch force. Similarly, to examine force relaxation, Taylor et al[22] stretched rabbit extensor digitorum longus muscles to 10% of their resting length and immediately returned the muscles to their initial position. Ten trials were performed on each muscle. Across the trials, a 16.6% decrease in peak tension occurred to assume the stretched position. Thus, a decrease in muscle stiffness, force per unit length, is a significant effect of stretching.

The consequence of reduced muscle stiffness upon muscle injury is uncertain. The previous study concerning muscle

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stiffness suggests that, at a given muscle length, cyclic stretching will reduce the force that is placed upon the muscle and associated connective tissue.[22] Theoretically, less tension will be applied within the musculotendinous tissue when it is subjected to the changes in joint motion that accompany sport or recreational activity. Thus, the potential for musculotendinous strain throughout the normal range of motion will be reduced by elongation of the musculotendinous unit.

Garrett[25] specifically addressed the beneficial effects of musculotendinous stretching on muscle injury characteristics. He reported that, after 10 cycles of stretching to 50% of the previously determined failure length, rabbit musculotendinous units achieved greater length before injury. At failure, no difference existed in force or energy absorption between the stretch and control groups.[25] However, when the musculotendinous units were stretched to 70% of the previously determined failure length, macroscopic disruptions in the muscle's integrity appeared before the 10 stretching cycles were completed. These findings indicate that, for an individual muscle, there is a maximum amount of force and energy that can be accommodated before musculotendinous unit failure. After a moderated stretching program, the musculotendinous unit will not experience these maximum values until it reaches a greater length.[25] Thus, during a specific sport activity, less force will be placed upon the musculotendinous units throughout the required arcs of motion, and, consequently, less energy will need to be attenuated. We believe these biomechanical characteristics provide the scientific rationale for implementing a stretching program for prevention of musculotendinous strains. Therefore, the purpose of our retrospective study was to compare the number of musculotendinous strains for the hamstrings, quadriceps, hip adductors, and gastrocnemius-soleus muscle groups before and after the incorporation of a stretching program for each muscle group.

METHODS

Study Parameters

We retrospectively studied the medical records of 195 Division III college football players (mean ht = 177.9 cm ± 6.25 cm; mean wt = 93.49 ± 18.5 kg; mean age = 18.6 ± 1.5 years) from the 1994 and 1995 seasons. We defined a musculotendinous strain as an acute injury to the musculotendinous unit, as determined by the clinical evaluation of a single certified athletic trainer. To be included in the study, the injury must have resulted in a decrease in function that caused a minimum 1-day absence from practice. Injury evaluation forms were completed for each injured athlete, and the injury was documented on a team injury report, which was a collective list of the year's athletic injuries recorded by the athlete's name, injury location and type, date of injury, and date of return to sport.

During 1994 and 1995, the practice schedule remained consistent. The subjects participated in general prepractice stretching for the upper and lower extremities, individual and agility drills, team hitting drills, and didactic sessions. Immediately after the didactic sessions, the subjects performed cardiovascular exercise and conditioning training. Typically, conditioning training consisted of 6 to 18 repetitions of 110-yard (100.58-m) sprints. Every sprint was required to be completed within a specified time relative to each subject's football position. In 1995, we incorporated a static stretching program into the practice schedule immediately before the conditioning training. Stretches were performed while standing and emphasized the hamstrings, quadriceps, hip adductors, and gastrocnemius-soleus musculotendinous units. The subjects were instructed to move into the given position until they felt a stretching sensation in the targeted muscle group and to hold the position for 15 seconds. Team captains led the stretching routine, and the players performed each stretch bilaterally 3 times. The athletic training staff circulated among the players during the routine to emphasize proper technique.

To stretch the hamstrings, the subjects stood with their feet shoulder-width apart and attempted to grasp their ankles by flexing their torsos while keeping their knees extended as much as possible. To stretch the quadriceps, subjects fully flexed their knees and grasped the foot with the ipsilateral hand to maintain the stretch. To increase the intensity of stretch, subjects hyperextended their hips. To stretch the hip adductors, subjects stood with their feet apart slightly wider than shoulder width and their toes pointing forward. They shifted their weight away from the extremity being stretched by flexing the other knee while the foot of the extremity being stretched maintained complete ground contact. To stretch the gastrocnemius-soleus complex, subjects stood with one leg positioned a stride's length in front of the extremity to be stretched. The subjects shifted their weight over the forward extremity by flexing the knee and hip. Subjects maintained knee extension of the extremity being stretched, and the heel remained in contact with the ground.

Statistical Analysis

To compare the incidence rate of musculotendinous strains for the 4 muscle groups between years, a χ^2 analysis was used. The probability level was set at $P < .05$.

RESULTS

During the 1994 football season, 155 injuries occurred, of which 27.7% were lower extremity musculotendinous strains. In comparison, during the 1995 football season, 153 injuries occurred, of which 13.7% were lower extremity musculotendinous strains (Table). A χ^2 analysis revealed a significant difference ($P < .05$) between the incidences of lower extremity muscle injuries in the 1994 and 1995 football seasons.

Injury Distribution

Region	Number of Injuries 1994	1995
Head and neck	17	18
Shoulder	10	34
Elbow	1	7
Wrist and hand	11	8
Thorax	5	7
Low back	14	11
Hip	6	0
Knee	27	19
Ankle and foot	19	24
Heat illness	2	4
Lower extremity musculotendinous injuries	43	21
Total	155	153

DISCUSSION

Stretching May Affect the Incidence of Musculotendinous Strains

Our results indicate that the number of musculotendinous strains was significantly reduced between 1994 and 1995. Specifically, musculotendinous strains were reduced 48.8% in 1995 compared with 1994 (43 versus 21 injuries). Multiple factors may be responsible for this reduction in musculotendinous strains. Due to the design of our study, we are unable to report cause and effect relationships. For several reasons, however, we do believe that this marked reduction in musculotendinous strains may be associated with the stretching program.

Our results are similar to the findings of Heiser et al,[16] but direct comparisons cannot be made due to methodologic differences. They reported a decreased incidence of hamstring muscle strains after the institution of isokinetic screening and a prevention program for hamstring strains. All subjects whose isokinetic hamstring:quadriceps strength ratio was less than 0.60 were required to begin an isokinetic strength program for their hamstrings. Their subjects, however, initiated a universal strength, stretching, and conditioning training program. As noted by the authors, many confounding variables may have influenced the reduction in hamstring strains.[16] Therefore, we believe that it is impossible to delineate the impact of each program on the reported injury reduction.

We believe that our study, in contrast to that of Heiser et al,[16] more effectively controlled the influence of extraneous variables other than the stretching program and supports the effect of static stretching during a college football season. Specifically, no changes occurred in the coaching staff, conditioning programs, or practice schedules during the years of this study. Thus, the strength and conditioning programs were consistent between seasons, with the only change being the lower extremity stretching program. Therefore, we speculate that the variables of strength, fatigue, and warm-up were comparable between the 2 seasons. Thus, we believe that our data support the incorporation of stretching programs as a means of preventing musculotendinous strains.

Limitations

As opposed to the traditional research paradigm in the laboratory, which tightly controls for the interaction of unrelated variables, we attempted to investigate the effects of a static stretching program in the athletic trainer's environment. As a consequence, factors other than the stretching program existed, such as the weather, field conditions, subjects' fitness levels, and the addition or loss of subjects due to recruiting or graduation, respectively. Accordingly, these confounding variables may influence our results. We believe, however, that our results have greater external validity and are more applicable to the practicing athletic trainer.

As previously noted, musculotendinous strains are complex injuries that may be influenced by flexibility, muscle strength, fatigue, and warm-up.[11] Additionally, the influence on musculotendinous strains of other factors, such as eccentric muscle contractions and nutrition, has also been speculated.[10,26,27] Our purpose was to evaluate the effects of a stretching program on the incidence of musculotendinous strains. We used static stretching and did not compare this technique with other stretching techniques. Furthermore, we did not take preseason and postseason goniometric measurements to assess changes in flexibility. Therefore, the stretching program's effect on flexibility could not be determined. More studies are required to investigate the characteristics of musculotendinous strains and their relationship with the aforementioned etiologic factors.

CONCLUSIONS

Our results suggest that the incorporation of a static stretching program immediately before strenuous activity was associated with a decrease in the incidences of musculotendinous strains of the lower extremity. Further research, especially prospective studies, is necessary to control the influence of confounding variables and to delineate the effects of stretching programs on the incidence of musculotendinous strains.

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Syndesmotic Ankle Sprains in Football: A Survey of National Football League Athletic Trainers

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Objective: To obtain information regarding syndesmotic ankle sprains and to identify a specific treatment modality that reduces the recovery time for syndesmotic ankle sprains.

Design and Setting: A mailed survey conducted from the Sports Medicine Department of Tufts University.

Subjects: I sent a survey to the head athletic trainers of all 30 National Football League teams. Of the surveys mailed, 23 (77%) were returned.

Measurements: The survey consisted of 8 questions pertaining to syndesmotic ankle sprains with respect to mechanism of injury, playing surface, diagnostic tests, immediate and follow-up treatment modalities, best treatment, recovery time, and taping procedure.

Results: A variety of causes were noted as being responsible for syndesmotic ankle sprains; the most frequently described mechanism of injury involved a rotational component. Playing surface was not thought to be a factor in the incidence of syndesmotic ankle sprains. Most athletic trainers (96%) indicated that plain radiographs were part of the diagnostic process, while 52% noted that magnetic resonance imaging was also ordered for suspected syndesmotic ankle sprains. The most frequently used modalities during the acute stage were ice, electrical muscle stimulation, casting or bracing (or both), and nonsteroidal anti-inflammatory drugs. Proprioception training, ultrasound, and taping were the most commonly used modalities during follow-up treatment. Immobilization, corticosteroid injection, and ice and exercise were reported to be the best treatments for reducing recovery time of syndesmotic ankle sprains.

Conclusions: To date, no treatment plan or modality for syndesmotic ankle sprains has been shown to effectively provide an early and safe return to football. Therefore, the need is clear for prospective studies comparing treatment protocols and severity of injury.

Key Words: diastasis, distal tibiofibular syndesmosis

Most ankle sprains in football involve the lateral ligamentous structures,[1–3] resolution of which is generally quite rapid and usually without long-term sequelae. However, the syndesmotic ankle sprain is a unique and frustrating injury, one that is commonly misdiagnosed[4,5] and results in an extended recovery period.[3,6–15] The syndesmotic sprain is a high ankle sprain that involves the anterior and posterior tibiofibular ligaments, as well as the interosseous membrane. These structures are located above or more proximal to the lateral ligaments, which are more often injured than the syndesmosis.

I conducted a survey of National Football League (NFL) athletic trainers in an attempt to identify whether any particular treatment modality or modalities significantly reduced the recovery time of football players with syndesmotic ankle sprains.

METHODS

I mailed a survey questionnaire to all 30 head athletic trainers of the NFL during the third week of October 1997; 77% (23/30) responded. NFL athletic trainers were chosen for this survey because the incidence of syndesmotic ankle sprain is thought to be greater in collision sports, such as football and ice hockey.[6]

My survey asked NFL athletic trainers to respond to questions pertaining to their experience in treating syndesmotic ankle sprains. However, it is not known whether responses were based on past experiences or on injuries currently being treated. The questionnaire included questions on syndesmotic ankle sprains with regard to the following: the most frequent mechanism of injury, playing surface, diagnostic tests, treatment modalities employed during immediate and follow-up treatment, the best treatment modality for reducing recovery time, length of time lost, and any special taping procedures used when returning athletes to practice or competition.

RESULTS

Mechanism of Injury

NFL athletic trainers were asked to indicate what they believed to be the most frequent mechanism of injury of syndesmotic ankle sprains. A wide variety of causes of

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syndesmotic sprains was reported. While most causes involved complex mechanisms, there were components common to most situations (Table 1).

Playing Surface

NFL athletic trainers were asked whether they believed the type of playing surface had any effect on the incidence of syndesmotic ankle sprains. Sixty-one percent indicated that surface type was not a factor, 26% were unsure, and 13% felt that the incidence of syndesmotic ankle sprain was higher on artificial surfaces. One athletic trainer felt that the incidence was the same regardless of surface type; however, he felt that the severity of injury was greater on artificial turf.

Diagnostic Tests

NFL athletic trainers were asked to indicate which diagnostic tests, other than clinical examination, were routinely ordered with syndesmotic ankle sprains. While all rely on the physical examination to identify this injury, other diagnostic tests were frequently obtained. Ninety-six percent routinely ordered plain radiographs, and 52% stated that magnetic resonance imaging was conducted for suspected syndesmotic ankle sprains. One NFL athletic trainer indicated that computed tomography scanning was part of the diagnostic process for this type of injury.

Time Lost from Participation

The survey asked athletic trainers about the average length of time lost from participation using their present treatment protocol (Table 2). The responses to this question were quite varied, as noted by the fact that the range of time lost was 5 to 56 days. It is important to recall that NFL athletic trainers were not asked to compare time lost with the severity of injury. Rather, they were asked to compare average recovery time with their present treatment protocol.

Treatment Modalities

NFL athletic trainers were specifically asked to indicate which therapeutic modalities were used during the immediate and follow-up phases of treatment. Additionally, I asked them to indicate the one modality they believed was the most important for reducing the recovery time of syndesmotic ankle sprains (Table 3).

Table 1. Common Components of Injury Mechanisms

Component	Number of Responses
External rotation	16
Plantar flexion	6
Various mechanisms	1

Table 2. Average Recovery Time (Date of Injury to Date of Return) for Syndesmotic Ankle Sprains

Recovery Time	Time (days)
Range	5–56
Median	30.5
Mode	28
Mean	27

Table 3. The Most Important Modality for Reducing Recovery Time of Syndesmotic Ankle Sprains

Most Important Treatment	Number of Responses (N = 23)
Immobilization	6
Corticosteroid injection	3
Ice	3
Rest	2
Proprioception training	2
Corticosteroid injection and immobilization	1
Ice and exercise	1
NSAIDs	1
All modalities equally important	1
Fixation screw	1
None	1
"I wish I knew"	1

Although many modalities were used initially, there does seem to be a common pattern of management of the syndesmotic ankle sprain. Modalities used in the immediate phase by more than 60% of athletic trainers responding included ice, electrical muscle stimulation, casting or bracing, and nonsteroidal anti-inflammatory drugs (NSAIDs).

The follow-up care also included a wide spectrum of modalities. However, proprioception training, ultrasound, and taping were used by at least 70%. Ice, electrical muscle stimulation, iontophoresis, NSAIDs, and stretching were used by at least 42% during the follow-up phase of treatment. Of the treatment modalities reported as being the best for reducing recovery time, immobilization, corticosteroid injection, and ice and exercise were indicated most often.

Other treatment choices indicated as the best included ice, rest, proprioception training, NSAIDs, and fixation screw; one respondent stated that all treatment modalities were equally important. Of note, one athletic trainer believed no treatment was really effective in reducing recovery time of syndesmotic ankle sprains, and another stated, "I wish I knew" about the best treatment.

Taping Techniques

Sixty percent of responding NFL athletic trainers answered a question asking them to describe any special taping procedure they employed when returning the athlete to football participation after a syndesmotic ankle sprain. Although, as expected, the responses were all different, 26% indicated that they attempted to counter the force responsible for the injury. For example, if dorsiflexion and external rotation were thought

to be the causative forces, then these motions were restricted in the taping process. Compression of the distal tibiofibular syndesmosis above the malleoli was identified by 17% as part of their taping procedure.

Of note, semirigid cast tape was used by 3 athletic trainers as part of their taping technique for syndesmotic ankle sprains. Five athletic trainers used, in conjunction with tape, some form of brace or custom orthosis to counter rotational forces. One athletic trainer applied a back plaster over the injury site to promote circulation, in addition to adhesive taping. One athletic trainer stated that, in his experience, taping the syndesmotic ankle sprain increased pressure and pain; therefore, he did not tape these injuries.

DISCUSSION

Since the syndesmotic ankle sprain represents damage to the ligaments of the distal tibiofibular syndesmosis, in particular the anterior and posterior tibiofibular ligaments, it would follow that a rotational force causing the talus to impinge on the distal tibia and fibula may be a primary cause for damage to the distal tibiofibular syndesmosis.

Various mechanisms have been reported as the causative factor for syndesmotic ankle sprains.[9] Our survey suggests that the most common mechanism involves external rotation of the foot. Many other researchers also believe that external rotation of the foot is the primary cause of syndesmotic ankle sprains.[5–9,15–17] Additionally, other authors suggest that a concomitant deltoid ligament injury usually accompanies a syndesmosis sprain, because it is their belief that eversion and external rotation of the ankle and foot are the mechanisms of injury for syndesmotic ankle sprains.[5,8,10,16]

Supporting the survey results, Boytim et al,[6] in a review of ankle sprains to professional football players, also concluded that neither surface nor shoe type was a factor in syndesmotic ankle sprains; rather, this particular injury was the result of the kind of considerable force that was most commonly seen in collision-type sports such as football or ice hockey (and was rarely seen in basketball). Guise,[8] similarly, in his study of rotational ankle injuries in professional football, could not find any connection between the severity of injury and the type of playing surface. However, he did suggest that footwear with a small sole surface on a large foot may predispose the foot to be easily supinated or pronated, or both, which may lead to ankle injury.

The clinical examination is believed to be the most reliable evaluative tool for diagnosing syndesmotic ankle sprains.[3,4,6,8,10,14–16] Clinical tests that clearly identify syndesmotic ankle sprains include the external rotation test, as described by Boytim et al,[6] the squeeze test, as described by Hopkinson et al,[9] and direct palpation of the ligaments associated with the distal tibiofibular syndesmosis.[3–6,8,10,13–16,18] The proximal fibula should also be evaluated to rule out a Maisonneuve fracture, which can be a consequence of rotational ankle injuries.[6,11,18]

Due to the nature of the syndesmotic ankle sprain and the considerable injuring force involved, radiographic studies should be obtained to rule out fracture. In those cases in which initial radiographs are normal, yet significant injury is suspected or pain persists, follow-up radiographs should be obtained to rule out heterotopic ossification or the development of a synostosis within the interosseous membrane.[3,5] Furthermore, stress radiographs are strongly suggested to rule out latent diastasis in cases of persistent pain and disability.[3,9,15] While 52% of the responding NFL athletic trainers indicated that routine magnetic resonance imaging is done for suspected syndesmotic ankle sprains, there is virtually no mention of this type of diagnostic testing for this particular injury in the literature. Instead, computed tomography and arthrography are mentioned as diagnostic tools in cases of suspected syndesmotic sprains.[3,4,9] The varied causes of syndesmotic ankle sprains would dictate that the athletic trainer and team physician evaluate all ankle sprains for potential injury to the distal tibiofibular syndesmosis and rule out pathology to the proximal fibula as well.

Unanimous agreement exists that sprains of the syndesmosis require an extended period of recovery before athletes can return to strenuous athletic activity and, even then, that symptoms may persist for months.[3,6–15] Why does the syndesmotic ankle sprain require such an extended recovery process? The answer to this question may lie in the biomechanics of the distal tibiofibular syndesmosis. During dorsiflexion, the distal fibula moves laterally away from the tibia, and, at the same time, it is pulled superiorly, which brings the fibers of both the tibiofibular and interosseous ligaments into a more horizontal alignment. When the ankle is plantar flexed, the opposite occurs, with the fibula being pulled inferiorly by the flexors of the foot, which causes the fibers of the anterior tibiofibular ligament to assume a more vertical alignment.[19–22] This position would tend to elongate the anterior tibiofibular ligament, causing pain in the presence of injury.

Additionally, the distal tibiofibular ligaments slightly overlap the mortise and can be nicked by the talus during plantar flexion and dorsiflexion.[19] This impingement of injured tibiofibular ligaments might well be exacerbated when they are swollen and inflamed, which may be why the athlete complains of pain with these motions.

Indeed, pain with pushing off is one of the major complaints preventing early return to sport of athletes with syndesmotic ankle sprains.[11,13,15] The development of heterotopic ossification or a synostosis alters the normal fibular biomechanics, resulting in continued pain and discomfort.[13,21,23,24] Hopkinson et al[9] suggested that extended recovery may be due to increased soft tissue swelling, while others noted that swelling is sometimes less with syndesmotic sprains than with lateral ligament sprains.[6,7,15] The most likely cause of extended recovery time, however, is stress on the syndesmosis during activity, which may account for persistent pain and discomfort even in those cases where heterotopic ossification or synostosis is not a factor.

Table 4. Time Lost from Sport by Treatment

Treatment	Time Lost (days) Mean	Range
Corticosteroid injection	17	7–35
Proprioception training	20	5–28
Ice	22	21–24
Immobilization	25	7–42
NSAIDs	35	28–42

Ice, compression, and the early, normal use of the joint after lateral ankle sprains is a widely accepted treatment and has been shown to return the athlete quickly to sports.[4,23] Yet, in the case of syndesmotic ankle sprains, some period of immobilization, whether casting or bracing, may be of benefit. Guise[8] believes immobilization, for at least 2 to 4 weeks, is the appropriate treatment of ankle injuries resulting from pronation and external rotation and feels this plan of management returns players to activity most quickly.

Table 4 compares time lost from sport by treatment. Again, severity of injury is not taken into account. However, we cannot ignore the fact that 70% of NFL athletic trainers responding to this survey employed some form of casting or bracing in the management of syndesmotic ankle sprains.

With the development of NSAIDs, the practice of injecting corticosteroids into tendons and ligaments has decreased and become somewhat controversial.[25] Boytim et al[6] mentioned a number of treatment modalities, including corticosteroid injection, in the management of syndesmotic ankle sprains, while Jackson et al[26] did not believe that injecting anesthetic agents or corticosteroids, or using oral or systemic proteolytic enzymes, reduced recovery time in ankle sprains. It is interesting to note that 4 NFL athletic trainers listed corticosteroid injection as the best treatment for reducing recovery time.

As yet, no specific program of management has been described for syndesmotic ankle sprains that clearly returns the athlete to competition quickly and without residual symptoms. Brosky et al[7] outlined a very detailed 4-phase treatment and rehabilitation program after syndesmotic ankle sprain. However, while their program is very comprehensive, the length of time from injury to return to athletic participation is 4 to 8 weeks.

Early mobilization and normal use of the ankle are encouraged for lateral sprains, but the best management of syndesmotic sprains may require some period of rest and immobilization. Comparing specific treatment regimes and severity of injury may supply additional information as to how to best treat this injury. The frustration this injury presents athletes, coaches, and medical personnel clearly suggests the need for further prospective studies.

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Collegiate Coaches' Knowledge of Eating Disorders

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Objective: To assess, through exploratory research, 1) collegiate coaches' knowledge of eating disorders, 2) the confidence of collegiate coaches in their response correctness to questions about eating disorders among athletes, and 3) demographic data related to prior education about eating disorders and the role of the athletic department in providing such educational experiences.

Design and Setting: We distributed a 2-part questionnaire to 258 NCAA Division I-A coaches from 5 universities selected by sampling convenience.

Subjects: One hundred thirty-eight collegiate coaches responded to the questionnaire for a response rate of 53.5%.

Measurements: Our survey consisted of 30 true-false questions that tested knowledge of eating disorders overall and in 5 domains. These domains included etiology, identifying signs and symptoms, management and treatment, risk factors, and education and prevention of eating disorders. Coaches indicated their level of certainty in their responses by rating their confidence level on a 4-item Likert-type scale. Demographic data focused on educational programs attended by coaches and teams. Descriptive statistics were used to analyze all data.

Results: Our results suggest a need for coaches to achieve a greater knowledge of eating disorders in all domains. Evidence showed that educational programs about eating disorders were not often sponsored by the athletic department for coaches or athletes. There seemed to be poor communication between athletic departments and coaches regarding the availability of eating disorder educational resources.

Conclusions: Data suggested coaches could benefit from comprehensive education in all domains of eating disorders; however, further study is needed to validate these findings, to determine the actual effectiveness of education in the prevention of eating disorders, and to differentiate coaches' knowledge specific to sport coached and to coach and team sex.

Key Words: anorexia nervosa, athlete, education, prevention

Although the prevalence of eating disorders has increased alarmingly over the past 2 decades, such self-imposed practices date back to the Middle Ages[1–4] and seem to occur more frequently in certain cultures or populations.[5] Mangweth et al[6] found that Americans may be more predisposed to a critical view of their bodies due to cultural pressures alone. Pressures placed on athletes to have the "ideal" body may compound the problem and further differentiate American athletes as a high-risk population within an affected culture. A 1992 study by the National Collegiate Athletic Association (NCAA)[7] reported that 70% of the responding institutions (312 of 443) had at least 1 case of an athlete with an eating disorder. This was a 6% increase over the same study done in 1990.[8,9] Although eating disorders are not directly "caused" by participation in athletics, the athletic environment may precipitate or exacerbate such a disorder in a susceptible individual.[2,8–17]

DePalma et al[18] concluded from their study of 131 lightweight football players that the "teacher/coach" was perceived to be the individual who encouraged dieting practices most often. This is a cause for concern, since 42% of the players showed evidence of disordered eating practices. Coaches and others in the sports environment need to be aware of inappropriate practices, behaviors, and misconceptions that can trigger an eating disorder in a susceptible athlete.[2,12,17,19] Coaches have a great deal of influence over athletes, so they are in a position to play a primary role in the prevention and management of eating disorders in athletes. Pliner and Haddock[20] found that female subjects who showed increased anorexia nervosa characteristics were more sensitive to wishes, opinions, or corresponding positive or negative feedback from others. This may suggest that athletes who are predisposed to developing an eating disorder may take comments from coaches more seriously and personally because of their greater need for approval, particularly from a coach. Studies by Rosen and Hough[21] and by Harris and Greco[22] showed how coaches could negatively influence athletes. In these studies, female gymnasts resorted to pathogenic dieting practices after reporting pressure from coaches to lose weight. It is apparent from such research that coaches can influence the actions of their athletes. For this reason, coaches should be properly edu-

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cated about eating disorders and related topics, so they can feel confident that they are enhancing the health of their athletes and not contributing to the possible development of an eating disorder.

The purpose of our investigation was to assess collegiate coaches' knowledge about eating disorders among athletes. This assessment could be useful for setting up appropriate educational programs to increase the active role of coaches in the prevention and management of eating disorders in athletes. Powers and Johnson[23] believe that governing bodies within the athletic community play a primary role in prevention efforts. Since the athletic department governs the university's athletic community, the department should create policy to ensure education about eating disorders for coaches and athletic teams. For this reason, we collected demographic data to see what role the athletic departments played in the education of coaches and athletes regarding eating disorders.

METHODS

Since we were unaware of any available instruments with which to measure knowledge of eating disorders, we designed a 2-part questionnaire to collect such data from collegiate coaches. The instrument was critiqued by 11 experts in the following relevant disciplines: athletic training, exercise physiology, nutrition, psychiatry, sport administration, sport psychology, sport science, and sports medicine (physicians). Seven of these 11 individuals are respected experts in the area of eating disorders and have published extensive literature on the subject. All reviewers had at least a general background in sports nutrition and eating disorders. The questionnaire was also examined and completed by 10 coaches at 2 participating institutions in a pilot study. Suggestions from the experts and coaches were taken into consideration, and appropriate corrections of the instrument were made.

Instrumentation

The questionnaire contained both demographic and survey sections. The survey was divided into 5 sections to assess the knowledge of coaches on specific aspects of eating disorders. These sections each contained 6 true-false statements on 1) etiology, 2) identifying signs and symptoms, 3) risk factors, 4) prevention and education, and 5) management and treatment. Coaches indicated their confidence in the correctness of their response to each statement on a 4-item Likert-type scale.

Procedures

After project approval from the Institutional Review Board at the University of North Carolina at Chapel Hill, we contacted the athletic directors of 5 NCAA Division I-A institutions to explain the purpose, possible significance, and intended procedures of the study. Four of these universities were members of the Atlantic Coast Conference, and one was a Big Ten Conference member. These universities were selected based on sampling convenience. After each athletic director agreed to participate, we modified procedures according to individual institution allowances. Athletic directors provided a listing of all female, male, head, assistant, and graduate assistant coaches.

An informed proxy attended a coaches' meeting at 2 universities to seek participation from all coaches. The proxy explained the purpose, possible benefits, assurance of confidentiality, instructions, and time needed to participate. A consent form was also included and explained. All coaches not in attendance had questionnaire packets placed in their mailboxes; each packet included an explanatory cover letter, a human consent form, and a coded questionnaire. All coaches from the remaining 3 institutions were sent questionnaire packets directly, since there were no other coaches' meetings scheduled during our available time frame. Those coaches not responding within 2 weeks were sent a follow-up letter and questionnaire.

RESULTS

Demographic Results

Of a possible 258 Division I-A coaches from 5 selected universities, 42.2% (n = 109) responded initially. We conducted a follow-up study, which increased the response rate by 11.2% (n = 29), producing a total response rate of 53.5% (N = 138). Frequency reports differ slightly throughout the demographic results due to some instances where demographic questions were left incomplete. All demographic and survey data were analyzed by descriptive statistics. Data were analyzed collectively, instead of by institution, due to the small sample size at each university.

Males constituted 70.1% (n = 96) and females, 29.9% (n = 41) of the sample. One coach did not indicate sex. Most responses came from assistant coaches (58.4%, n = 80). Thirty-five percent (n = 48) of head coaches, 4.4% (n = 6) of graduate assistant coaches, and 2.2% (n = 3) of "other" coaches indicated their current positions. These coaches represented 18 different sports, which were not differentiated according to sex. Approximately 48% (n = 66) of the respondents coached male athletes, 38.7% (n = 53) coached female athletes, and 13.1% (n = 18) coached both female and male athletes. The mean total number of years coaching was 13.3 years, with a range of 1 to 45 years.

Table 1. Coaches' Attendance at Eating Disorders Educational Programs (N = 138)

Attendance	No. (%)
Ever attended	61 (44.2)
Within past year	57 (41.3)
Within past 5 years	33 (23.9)
Sponsored by athletic department	37 (26.8)
Mandatory attendance	23 (16.7)

Coaches indicated whether or not they had ever attended an educational program about eating disorders, whether or not it was sponsored by the athletic department, and whether attendance was mandatory (Table 1). Coaches also stated whether their teams had attended an educational program about eating disorders. Of the 127 coaches who responded, 61.4% (n = 78) reported that their teams had not attended such a program within the last year. Thirty-three of 39 who responded indicated that attendance was mandatory, representing 23.9% of the total sample (N = 138) of coaches.

Coaches also indicated which educational resources regarding eating disorders were made available by the athletic department. Although subjects reported literature to be the resource most readily available (n = 52), most subjects were not aware of any educational resources available from the athletic department (n = 53) (Table 2).

Survey Results

The frequency of individual correct responses was calculated and organized into 6 differentiated percentage groups with scores falling into a normal distribution (Table 3). Table 4 shows the percentage of correct and incorrect responses for each domain compared, in rank order, with mean confidence levels of correct versus incorrect responses for each domain. The domain with the highest mean percentage incorrect (education and prevention) showed the highest mean confidence level for incorrect responses. This domain also showed the highest composite mean confidence level (19.6 ± 3.5) (Table 5). The mean composite confidence level for each domain was then compared, in rank order, with the mean percentage of correct responses for each domain (Table 5). The mean composite confidence score was calculated by summing each individual's confidence level for each question in the domain. A sample mean was then derived for composite confidence scores in each domain.

DISCUSSION

Educational Programs for Coaches

Despite a lack of concrete documentation, experts[17,19,24–30] agree that education is a primary tool for minimizing the risk of eating disorders and that coaches, parents, athletes, and sport-related personnel should all be included in educational programs. We found that less than half of the coaches (44.5%) reported ever having attended an educational program about eating disorders. Although coaches should be responsible enough to seek education on potential problem areas such as eating disorders, in our opinion it should be the responsibility of the athletic department to establish and implement educational programs for athletes, coaches, and others who work closely with athletes.

Table 2. Eating Disorders Educational Resources Available from Athletic Departments According to Coaches (N = 138)

Resource	No. (%)
Video	12 (8.7)
Literature	52 (37.7)
Sponsored programs	39 (28.3)
Other sources	28 (20.3)
Not aware of available sources	53 (38.4)

Table 3. Distribution of Coaches' Scores on an Eating Disorders Questionnaire (N = 138)

Percentage Correct	No. of Coaches (%)
100–90	6 (4.3)
89.5–80	41 (29.7)
79.5–70	44 (31.9)
69.5–60	34 (24.6)
59.5–50	8 (5.8)
Below 49.5	5 (3.6)

Approximately 27% of the total sample indicated that they had attended an eating disorders educational program sponsored by the athletic department, and only 16.7% reported mandatory attendance. Forty-seven percent of the coaches did not know if such a program was sponsored yearly. In these last cases, if a program existed, we speculate that attendance was not mandatory and that communication between the department and the coaches was minimal. The low rate of attendance and knowledge of program existence is a cause for concern since the athletic department acts as the organizational body for all coaches and teams. Those policies, procedures, and preventative guidelines enforced by the athletic department will be carried out by coaches and department personnel and, in turn, will benefit the health of the athletes.

Educational Programs for Athletes

Coaches and teammates are often the first to suspect that an athlete has a problem, due to their close daily contact. This is only one of many reasons why it is imperative for coaches and teams to be educated about signs, symptoms, and other issues related to eating disorders. Only 38.3% of the coaches reported that their teams had attended a program about eating disorders in the past year, and 23.9% indicated mandatory attendance. Where eating disorders programs are not sponsored by departments for coaches or teams, we hope coaches will see the importance of finding resources to educate themselves and their teams.

Educational Resources

Besides attending educational programs, there are many ways of becoming knowledgeable about eating disorders, including literature, videos, and outside programs. Coaches were asked what educational resources were made available to them and their teams by their athletic departments. Only 12 (8.7%) individuals reported that videos were available, while 52 (37.7%) indicated that literature regarding eating disorders

Table 4. Distribution of Coaches' Scores (with Confidence Levels) by Domain on an Eating Disorders Questionnaire*

Domain	Correct Responses		Incorrect Responses	
	Mean Percentage	Mean Confidence	Mean Percentage	Mean Confidence
Risk factors	80.0	3.0	20.0	2.6
Etiology	73.9	3.0	26.1	2.7
Identifying signs and symptoms	73.8	2.9	26.2	2.5
Management and treatment	70.6	3.0	29.4	2.7
Education and prevention	68.5	3.3	31.5	3.1

* Confidence range: 1 = not at all confident; 4 = very confident.

was accessible for educational purposes. This is especially astonishing, because in 1989 the NCAA provided each NCAA-affiliated school with 2 educational videos, as well as supplemental literature about eating disorders.[10–12] It is important that athletic departments make coaches cognizant of educational material available to them. Even if the NCAA had not provided such resources, one would hope that athletic departments would have taken the responsibility to create educational opportunities and communicate with coaches and teams about the availability of such educational tools. In this study, 38.4% (n = 53) of the coaches were not aware of any eating disorders resources available from the athletic department.

Survey Data

Scores seem to fall into a normal distribution, with the fewest frequency of individual percentage of correct responses falling at the ends of the distribution. Only 4.3% of the sample scored 90% correct or greater. Most (31.9%) scored between 70% and 79.5%. Although a distribution of this manner is considered normal, it may not be desired in this case. Eating disorders can be a matter of life or death, and coaches can significantly affect the prevention or exacerbation of these harmful disorders. The question remains to be answered as to what amount of knowledge is enough to prove helpful and not harmful with regard to eating disorders in athletes. This study showed that most coaches had a sizable amount of knowledge left to obtain. This point is profoundly emphasized by the 34 coaches (24.6%) who scored between 60% and 69.5% and the 13 coaches (9.4%) who scored below 60% correct (Table 3). A mean percentage correct value was computed for each of the 5 domains (Table 4). The risk factors domain had the highest percentage correct, and education and prevention had the lowest percentage correct. Since experts believe that education plays a primary role in the prevention of eating disorders, there could be serious implications if coaches lack considerable knowledge in this domain.

The overall mean score for the 5 domains was 73.4%, with a range of 68.5% to 80.0%. There is no score from other research with which to compare true knowledge, but data from this study imply the need for further education of coaches in all domains. Although the determination of an acceptable score remains an individual decision, personally or institutionally, one has to keep in mind the consequences that may result from an avoidable lack of knowledge about eating disorders.

Table 5. Rank Ordered Mean Composite Confidence Levels Compared with Mean Percentages for the 5 Domains on an Eating Disorders Questionnaire

Domain	Mean* ± SD	SE	Mean Percentage Correct
Education and prevention	19.6 ± 3.5	.30	68.5
Management and treatment	17.9 ± 3.2	.28	70.6
Risk factors	17.62 ± 3.8	.33	80.0
Etiology	17.59 ± 3.2	.28	73.9
Identifying signs and symptoms	16.5 ± 4.2	.36	73.8

* Possible mean composite range: 6–24.

Coaches' Confidence Levels

Knowledge of eating disorders, alone, is not the only factor. One's confidence in that knowledge plays an important role. Coaches who have a high level of confidence in their knowledge but actually have a low knowledge score could pose more of a threat than an individual with a high knowledge and low confidence score. Individuals who are very confident in their level of knowledge about eating disorders may offer suggestions or tips or impose ideas about an athlete's weight, body fat, nutritional needs, or so forth. If these individuals actually have a low level of accurate knowledge about eating disorders, the information they offer may be incorrect or they may inadvertently promote harmful eating or dieting practices. An example of this can be seen in Benson's study[31] of 394 elite female swimmers. Of the 70% of athletes who reported that coaches told them to lose weight, 36% thought that the weight loss requested by the coach was detrimental to their performance. Coaches who are properly educated about weight loss may be more confident in their knowledge. These coaches may then feel more assured that they are offering sound advice about nutrition, body composition, and weight loss that would help and not hinder the health and performance of athletes. Ideally, those coaches not confident in their knowledge would first seek correct information from a knowledgeable source before offering any diet or nutrition advice to athletes.

Survey results (Table 4) showed that the domain with the lowest percentage correct (education and prevention) had the highest mean confidence response. Mean composite confidence scores compared with mean percentage correct (Table 5)

showed similar results; the education and prevention domain had the highest mean composite confidence level and the lowest mean percentage correct. In other words, individuals generally indicated a higher confidence level across this domain, although they answered more questions incorrectly in this area. This domain, which obviously had the highest mean percentage incorrect, also showed the highest mean confidence score for incorrect answers. To reiterate, coaches were more confident that they answered questions correctly when in fact they actually answered more questions incorrectly in the education and prevention domain. This could have serious implications, given the previous scenario described.

The domain with the highest percentage correct (risk factors) fell in the middle of the composite confidence ranking, indicating that coaches were only moderately confident in their responses in this area. In general, since the majority of coaches did not have a strong level of confidence, coaches need to be educated about risk factors so that they are confident in the accuracy of their knowledge in that domain area. Overall, coaches who exhibit a greater confidence in their knowledge may be more likely to actively participate in the prevention and management of eating disorders in athletes.

Composite means, standard deviations, and standard error scores are seen in Table 5. Although means are very close (range 16.5–19.6) for the 5 domains, standard deviations and standard errors are low. Low standard errors can imply accurate generalization to true population means. The low sample number and restricted geographic area of the study, however, decrease true representation of an NCAA Division I-A coaching population.

CONCLUSIONS

This study offered much insight regarding collegiate coaches' knowledge of eating disorders. Results suggested that coaches could benefit from comprehensive education in all domains of eating disorders. It is important that information relayed to coaches comes from knowledgeable, accurate sources. We recommend that coaches attend educational programs yearly, to reinforce their confidence in their knowledge. Coaches who are more confident in their knowledge will take a more active role in the prevention and management of eating disorders in athletes. We suggest that athletic departments take the responsibility to educate coaches, athletes, and those department members who work closely with athletes.

Although this study looked at past educational programs attended by coaches, these data were not correlated with actual knowledge scores. Research that directly compares knowledge of eating disorders with past educational experience could be very beneficial, as could research that determines the actual effectiveness of education in the prevention of eating disorders. Further study that differentiates coaches' knowledge specific to sport coached and in relation to their sex and the sex of their team could also be useful in the development of proper education and prevention programs. Perhaps most important, we recommend validation of an instrument to measure knowledge of eating disorders. Evidence presented in our research suggests a need for further understanding of the knowledge levels of coaches regarding eating disorders. A standardized instrument to measure the prevalence of eating disorders in athletes also needs to be created in order to fully understand the implications of lack of knowledge about eating disorders in the athletic environment.

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Traumatic Hyphema in an Intercollegiate Baseball Player: A Case Report

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Objective: To present the case of a collegiate baseball player struck in the right eye.

Background: While attempting a bunt, a 20-year-old collegiate baseball player was hit in the right eye when the ball was deflected off the bat. The athlete bled from the nose, and the right eye swelled shut from eyelid edema. Initial nasal hemorrhage was controlled, and the athlete was referred to the emergency room for further care due to pain in the inferior orbit.

Differential Diagnosis: Eyelid contusion, traumatic iritis, or traumatic microhyphema to the right eye secondary to blunt trauma.

Treatment: Immediate treatment consisted of controlling the nasal bleeding with sterile gauze pads. Because of palpable tenderness over the inferior orbit, the athlete was immediately transported to the emergency room.

Uniqueness: Hyphema is one of the most common sport-related eye injuries: the incidence is 12.2 cases per 100,000 population, with approximately 37% resulting from sports injury. Racquet sports, baseball, and softball account for more than half of all hyphema injuries in athletics. Individuals with traumatic hyphema rarely require surgery; however, proper initial care, treatment, and referral are imperative to a good prognosis.

Conclusions: Athletic trainers need to be able to recognize the signs and symptoms of hyphema and seek medical evaluation immediately in order to avoid secondary complications. With proper recognition, initial care and referral, and appropriate, well-fitted protective eyewear as needed, hyphema can have minimal complications, and the athlete may be able to compete again within 1 to 2 weeks.

Key Words: cycloplegia, fundoscopy, gonioscopy, limbal tissue, tonometry

Hyphema is the accumulation of blood in the anterior chamber of the eye, and microhyphema is the term used for circulating red blood cells in the aqueous humor of the anterior chamber without grossly visible blood (Figure).[1–8] The anterior chamber is the aqueous-filled space between the cornea and the iris of the eye.[9] Traumatic hyphema is due to blunt trauma from a ball, racquet, or other object, and it increases the athlete's risk of compromised visual function.[1–3,5,10] Clinical symptoms of hyphema include pain, photophobia, blurring of vision, somnolence, and restlessness.[6] In addition, an associated increase in intraocular pressure (IOP) can cause nausea and vomiting. Pathologic consequences of traumatic hyphema include stretched limbal tissue, equatorial scleral expansion, posterior and peripheral movement of the aqueous humor, and posterior displacement of the lens or iris diaphragm.[3,5]

Hyphema patients are predominantly male (3:1 ratio), and 70% are under 20 years of age.[5,11,12] Schein et al[12] reviewed more than 3000 eye injuries in patients who presented to emergency departments of New England hospitals and showed that young men in their teens and 20s experience the most eye injuries.

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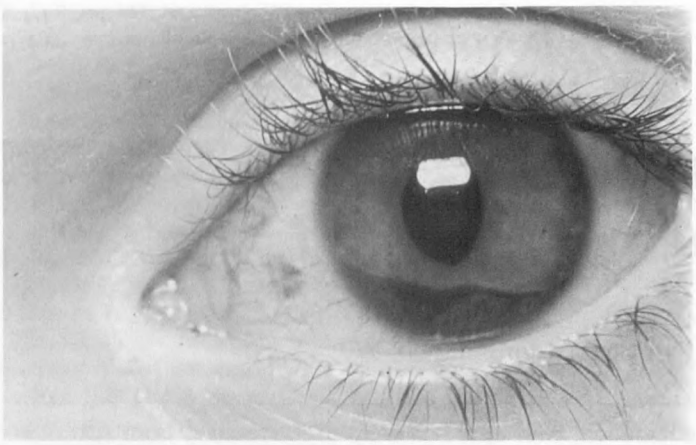
Sport-related eye trauma can be relatively minor, causing swelling and ecchymosis of the eyelids that last only a few days, or it can involve virtually every structure of the eye and orbit in all degrees of severity. Urgent ophthalmologic consultation is mandatory in cases of suspected hyphema.[6,11,13] When hyphema occurs within the athletic setting, often the injury is initially evaluated by a certified athletic trainer, who must be able to evaluate and refer the athlete for more definitive care in order to avoid severe long-term complications. Certified athletic trainers, therefore, play a critical role in the acute care of athletes with eye trauma.

Baseball accounts for a high incidence of injuries within the athletic and recreational settings in the United States, with most injuries resulting from direct contact with the ball.[14,15] Thus, ophthalmologists and manufacturers initiated eye protection for batters in 1980 and recommended that fielders wear racquet sport eye protection.[15] Nonetheless, the Consumer Product Safety Commission estimated that in 1993, hospital emergency departments throughout the country treated more than 41 000 eye injuries that were sport or recreation related, with baseball accounting for 14.9% of all eye injuries.[8]

CASE REPORT

While attempting to bunt a pitch from a pitching machine, a 21-year-old male collegiate baseball player was struck in the



Hyphema is the accumulation of blood in the anterior chamber of the eye. (Reproduced with permission from the American Academy of Ophthalmology, *Ophthalmology for the Emergency Room Staff*, a slide series, 1980.)

right eye when the ball was deflected off the bat. The athlete immediately dropped to his knees and held his face in his hands. Upon initial examination, blood was coming from the nose, and the right eye was swollen shut, with the lower eyelid covering the globe. The athlete complained of blurred vision and photophobia, but he was conscious and able to see from his left eye without difficulty. He was taken to the training room with minimal assistance from the athletic trainers.

Nasal bleeding was controlled with sterile gauze, and pressure was applied to the nose after palpation revealed no severe nasal trauma. Examination of the eye was difficult due to eyelid swelling, which felt much like an air pocket upon palpation. Ecchymosis was present in the lid, but no obvious palpable orbital bone deformities were noted. However, there was extreme tenderness over the orbital rim (zygomatic arch). The athlete had minimal to no pain over the remainder of the orbit and nose.

Increased tearing was noted, pupils were reactive to light, and a full range of tracking was present bilaterally. Because of the extreme tenderness of the inferior orbit with the rapid onset of lid edema, the athlete was transported to the emergency room for evaluation and definitive care.

In the emergency room, the athlete was examined, and x-rays were taken to rule out a possible orbital blowout fracture. There were no signs of entrapment of the inferior ocular tissue, and clinical examination revealed no signs of fracture. Skull and facial x-rays were negative. Normal ocular motility was present, and visual acuity was 20/20 bilaterally. However, the athlete's complaint of blurred vision remained (20/20, left eye; 20/20 blurred, right eye). As a result, the emergency room physician referred the athlete to an ophthalmologist for further examination.

The on-call ophthalmologist performed a tonometry test to determine IOP and a slit-lamp evaluation and dilated fundoscopic evaluation of the posterior eye to search for optic nerve damage or retinal detachment. After all examinations were complete, the diagnosis was microhyphema and iritis of the right eye secondary to blunt trauma. Immediate care involved patching the right eye after medications were given to dilate the pupil. Bedrest with the head elevated at a 45° incline was recommended to assist in the inferior settling of floating blood cells. The athlete was referred to the team ophthalmologist for follow-up the next morning.

Medications initially prescribed for the athlete were cyclopentolate and prednisolone acetate. Muscle spasm secondary to trauma can cause pain and further inflammation. Cyclopentolate relaxes the ciliary muscles (causing cycloplegia, paralysis of the ciliary muscles, which impairs the eye's focusing ability[16]) and dilates the pupil; it is given primarily to decrease inflammation, as well as to make the eye more comfortable. Prednisolone is a commonly prescribed corticosteroid that assists in inhibiting the inflammatory response.

After the injury, the athlete was seen daily for 6 days by the team ophthalmologist. Visual acuity was checked at every visit and was consistently within the 20/20 to 20/30 range. On day 6, the athlete had no complaints and was cleared to resume normal activity. Gonioscopy was attempted at 1-month follow-up to rule out angle recession in the anterior chamber of the eye but could not be completed due to the athlete's blepharospasm (squeezing of lids).

DISCUSSION

Grading

Hyphema is one of the most common serious sport-related ocular injuries.[15] Hyphema is classified by the amount of blood in the anterior chamber (Table 1). Initially, 50% to 60% of patients will fall into the grade I category. The literature refers to a grade IV or total hyphema (100%) as a "black ball" or "eight ball,"[7] which occurs when the entire anterior chamber is filled with blood.

Differentiating between hyphema and traumatic iritis is sometimes difficult. According to Catalano,[10] hyphema is characterized by red blood cells in the anterior chamber, as opposed to the white blood cells of iritis. The microscopic red and white cells have a subtle difference in color that can be appreciated only with slit-lamp biomicroscopy. Allowing the patient to sit quietly for several minutes allows red blood cells, which are dispersed with patient movement, to layer or clot, confirming the diagnosis of hyphema. The diagnosis is hy-

Table 1. Grading Scale for Traumatic Hyphemas[5]*

Grade	Size of Hyphema (Portion of Anterior Chamber Filled with Blood)
Microscopic	No layered blood; circulating red blood cells only
Grade I	Blood fills less than ⅓ of the anterior chamber
Grade II	Blood fills between ⅓ and ½ of the anterior chamber
Grade III	Blood fills more than ½ and just less than the entire anterior chamber
Grade IV	Blood fills the entire anterior chamber ("eight ball")

* Adapted courtesy of Mosby–Year Book, Inc.

phema when red cells are present in the anterior chamber. Traumatic iritis can occur in the absence of hyphema.

Mechanism

The mechanism of traumatic hyphema in sports is usually related to blunt trauma.[1,4,5,10] Indentation of the anterior surface of the eye results in the stretching of limbal tissues and elevation of IOP, which can cause tearing of the tissues in the anterior chamber angle of the eye. Hyphema can also be associated with surgical intervention or can occur spontaneously secondary to pre-existing pathologic processes, such as diabetes and certain clotting disorders.[3]

Immediately after a hyphema, decreased vision is almost always present. Causes of decreased vision can include corneal edema, corneal blood staining, anterior chamber angle damage with glaucomatous damage to the optic nerve, and possible damage to other ocular structures, such as the retina.[2] Should you suspect an athlete has sustained a hyphema-causing injury, it is important to record the time of injury and its mechanism. This information helps to identify the period of greatest risk for rebleeding and may provide insight into the degree of ocular damage.[1]

Treatment

The goals of immediate care are to minimize the initial bleeding and to prevent rebleeding. In the past, it was felt that bedrest with bilateral patching might decrease the likelihood of rebleeding in hyphema patients. However, others have noted no significant difference in results between patients undertaking moderate activity and those on strict bedrest.[5,7,17] Conservative treatment consists of placing the athlete in a supine and head-elevated position. This position assists the layering of the hyphema for prompt grading and aids the clearing of the visual axis in front of the pupil. An eye patch and shield should be applied for protection and to eliminate the rapid eye movements associated with reading, focusing, or sudden scenery changes. Such medications as aspirin, nonsteroidal anti-inflammatory drugs, and anticoagulants (eg, warfarin sodium) should be avoided because they prolong bleeding time, inhibit platelet activity, and may exacerbate bleeding.[9,18] Other guidelines for the treatment and management of hyphema are presented in Table 2.

Recent studies have shown that oral antifibrinolytic agents such as aminocaproic acid may aid in reducing the rate of secondary hemorrhage after hyphema. Antifibrinolytic agents purportedly function by stabilizing clots within the walls of damaged blood vessels.[19,20]

Complications

Major complications of hyphema include decreased visual acuity secondary to traumatic cataracts, lens opacities, choroidal rupture, vitreous hemorrhage, secondary glaucoma (which may lead to blood staining), retinal detachment, and secondary hemorrhage.[9,19] Long-term complications include angle recession glaucoma and optic nerve atrophy.[11] Secondary hemorrhage (rebleeding) usually occurs between the second and fifth days after injury. It is diagnosed by a fresh layer of blood in the anterior chamber upon slit-lamp examination.[2] Rebleeds are frequently of greater magnitude than the original hemorrhage and more likely to be associated with elevated IOP.[10,19,20] Both large and small hyphemas should be considered at risk for rebleeding.[1,8,19,20]

Table 2. Management of Hyphema*

Recommendations
Wear rigid eye shield at all times
Limit activities
Elevate head of bed to 30° to allow settling of blood
Induce cycloplegia (ie, 1% atropine 3 times a day)
Avoid aspirin-containing compounds
Use oral corticosteroids or antifibrinolytic agents, such as aminocaproic acid, in selected cases
Use appropriate agents if intraocular pressure is elevated
Determine patient's sickle cell status; if positive for sickle cell, avoid carbonic anhydrase inhibitors and osmotic agents
Follow-up daily with ophthalmologist

* Adapted from Zagelbaum[8] with permission of Blackwell Science, Publishers.

Fong[21] described 4 clinical concerns that are predictors of rebleeding. These include visual acuity of 20/200 or less, initial hyphema level of grade II or greater (>1/3 of the anterior chamber), elevated IOP above 21 mm Hg, and medical examination delayed more than 24 hours after injury.

Shingleton[9] indicated that 25% to 35% of patients with hyphema also have other eye damage. Rebleeding, glaucoma, and staining of the cornea with blood are 3 of the most important complications. Therefore, the initial treatment plan should be designed to minimize the potential of rebleeding and its associated complications.

Seventy-five percent of patients with hyphema end up with visual acuity better than 20/50. However, patients with large hyphemas, patients with episodes of rebleeding, and children have poorer prognoses.[9] When further visual reduction occurs, it is often due to associated damage in the posterior segment of the eye, involving the vitreous, retina, and optic nerve.[9]

Six percent to 10% of the African American population carries the sickle cell trait and disease, which should be given immediate consideration when dealing with hyphema. Studies have shown that sickle cell trait and disease are added risk factors that contribute to a greater incidence of secondary glaucoma in the African American and Mediterranean populations. Nasrullah and Kerr[18] found that African Americans less than 18 years of age who were negative for the sickle cell trait had no secondary hemorrhage after hyphema. However, 64% of African Americans less than 18 years of age who were positive for the sickle cell trait had secondary hemorrhage, in addition to higher IOP and permanent visual impairment.[18]

Individuals who are positive for the sickle cell trait are likely to have increased red blood cell sickling in the anterior chamber, which impedes aqueous outflow and elevates IOP. Thus, hyphema in a patient with sickle cell trait or disease is more likely to be associated with an elevated IOP, even when the hyphema is small. Therefore, African American athletes with hyphema who do not know their sickle cell status should have a sickle cell screen.[22]

CONCLUSIONS

This case report addresses the symptoms, treatment, and possible acute and long-term complications associated with hyphema. Hyphema should be treated as a serious condition in order to avoid possible long-term detrimental effects. In the case of microhyphema, assessment is not as easily performed when using only the visual examination, since layering is not present. However, complications such as continued bleeding or rebleeding with development into complete hyphema, or both, may be just as severe. Therefore, the certified athletic trainer needs to be able to recognize the other signs and symptoms associated with hyphema. With proper evaluation, treatment, and referral by the athletic trainer, both the acute and long-term complications of hyphema can be avoided.

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Vertebral Osteomyelitis in a High School Hockey Player: A Case Report

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Objective: To present the case of a high school hockey player with vertebral osteomyelitis in the body of the third lumbar vertebra.

Background: Vertebral osteomyelitis is an infrequently reported cause of back pain in otherwise healthy adolescent athletes. Osteomyelitis is an inflammation of bone caused by a pyogenic organism. It can remain localized or spread through the bone to involve the marrow, cortex, cancellous tissue, and periosteum.

Differential Diagnosis: Lumbar dysfunction, tumor, fracture, and degenerative conditions.

Treatment: High-dose intravenous antimicrobial therapy for 4 to 6 weeks is the rule; rest, limitation of movement, and analgesics as needed; and periodic reevaluation for complications.

Uniqueness: An otherwise healthy student-athlete developed low back pain with no history of acute trauma or significant medical history. Back pain and fever began approximately 4 weeks before the athlete reported to the athletic trainer. At the onset of symptoms, the patient took acetaminophen, which reduced the fever. Back pain remained, however, and increased to a radiating left-sided pain. At this point, the patient saw a pediatrician, who treated him for influenza-like symptoms with oral antibiotics. Symptoms decreased, probably from a dampening of the infection as a result of the antibiotics, but back pain was not completely resolved.

A magnetic resonance imaging scan was ordered by a consulting orthopaedic surgeon for suspicion of hereditary disc disease or infection. It was at this time that the patient presented his complaints to the school athletic trainer. The physical assessment was indicative of typical low back pain of a mechanical nature. Development of high fever and chills prompted the athlete's visit to the family physician, who reviewed the magnetic resonance imaging report of abnormal L3 vertebral body uptake and ordered standard blood work. His initial impression was a bone contusion and influenza-like symptoms. However, laboratory results 48 hours later suggested probable infection, and the athlete was referred to a pediatric orthopaedic specialist. A diagnosis of osteomyelitis was made, and the patient was admitted emergently for open biopsy, irrigation, and débridement. After appropriate treatment, he returned after 5 months to full activity with no complications.

Conclusions: Low back pain can have many etiologies. Health care providers need to be aware of the distinctive features of vertebral osteomyelitis, so that they can recognize the disorder and institute appropriate diagnostic testing and treatment. Early diagnosis and identification of the infecting microbe are the keys to determining the appropriate antimicrobial therapy and reducing complications and the need for surgical intervention.

Key Words: low back pain, lumbar vertebra, *Staphylococcus aureus*, spine

Low back pain in athletes is a common condition treated by certified athletic trainers. Patients with low back pain can be divided into 2 general categories: those with an underlying systemic disorder and those who are otherwise healthy with a chief complaint of back pain.[1] The latter group of patients are characterized as having mechanical back pain caused by some injury to muscles, ligaments, or neural tissue. Low back complaints often have a mechanical etiology.[1,2] However, a small percentage of patients with complaints of low back pain have systemic etiologies. The pain in these patients may be referred from another area of the body or caused by a disease process in the spine itself.[2]

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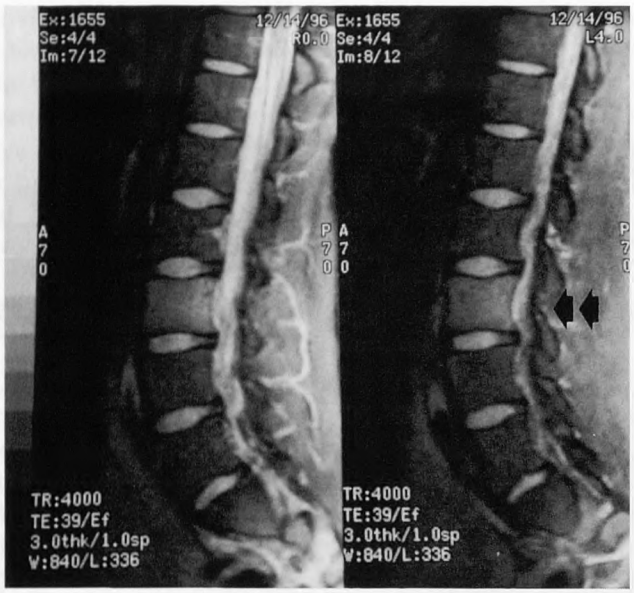
The distinction between a mechanical and systemic etiology is determined after a detailed medical history and a thorough evaluation of the patient.[1] An underlying systemic process may also be masked by mechanically based symptoms.[2] The athletic trainer must be cognizant of subtle differences that could suggest a systemic condition. In our case, the patient had no significant mechanical etiology, but presented with symptoms consistent with musculoskeletal injury. We present this case to demonstrate that a systemic condition, osteomyelitis, can manifest in the lumbar vertebrae and should be considered in the differential diagnosis of chronic low back pain of the adolescent athlete.

CASE REPORT

A 16-year-old male high school hockey player reported to the athletic training room with a chief complaint of low back



Note light uptake area at the L3 vertebral body.

pain, more intense on the left side, with radiating pain to the posterior thigh. There was no history of acute trauma; however, he reported very active and competitive skating and checking during hockey participation. There was no past history of back problems, and he was otherwise healthy, except for a recent upper respiratory infection, which was treated by his pediatrician. He had had mononucleosis the year before and had had a history of strep throat. His gait was normal, with guarded movement of the lumbar spine. He reported pain with movement of the back and of the left leg.

Clinically, the athlete presented without tenderness but with some spasm upon palpation of the paraspinal muscles. Trunk flexion was limited to 65° at the point of pain, extension to 5°, left lateral flexion to 10°, and right lateral flexion to 5°. A seated straight-leg raise test was negative bilaterally. With the athlete supine, the straight-leg raise on the right at approximately 70° produced lower back pain, which radiated to the left side; straight-leg raise on the left did not produce radicular pain. Active- and passive-assisted left hip flexion produced left lateral lumbar pain. Sensation to light touch at L1-S1 dermatomes was normal, as were L1-S1 motor function and reflexes. Hamstring flexibility bilaterally was approximately 70°, measured supine with knees straight.

The athlete's subsequent visit with his family physician revealed evaluative findings that were consistent with the athletic trainer's findings. Plain x-rays were unremarkable. A magnetic resonance imaging (MRI) scan, ordered earlier by a consulting orthopaedic physician, revealed abnormal uptake in the vertebral body of L3 without cortical destruction, prevertebral or paraspinal mass, or epidural tumor mass (Figure). No discrete focal disc herniation was seen. Differential diagnosis included metastatic disease, lymphoma, myeloma, and infection. The family physician's initial impression was a bone contusion from prior trauma, minor vertebral compression with secondary edema of the L3 body, or perhaps hemangioma. He believed the back symptoms were from muscular strain. He suggested ibuprofen and acetaminophen with restricted activities. Laboratory work, including complete blood count and erythrocyte sedimentation rate, was ordered as a routine precaution.

The laboratory results 48 hours later indicated a slightly elevated white blood cell count of $11\,600 \cdot 10^{-6}$ L (normal = 4000 to 10 500) and an elevated erythrocyte sedimentation rate of 56 mm/h (normal = 0 to 15). These results, combined with the MRI and physical findings, suggested probable vertebral infection, which prompted referral to a pediatric orthopaedic specialist.

Twenty-four hours later, the patient presented with fever and chills. The orthopaedic specialist's differential diagnosis at this time was round cell tumor, such as leukemia or lymphoma, versus vertebral osteomyelitis. The patient was advised of the need for emergency admission to the hospital.

The patient was taken to the operating room on the night of admission, where he underwent open biopsy and irrigation, débridement, and partial saucerization of the L3 vertebra. A retroperitoneal approach was made by starting with an incision halfway between the anterior superior iliac spine and the lower rib cage. When the L3 vertebra was identified through x-ray, the lateral portion of the vertebral body was then incised, and a curette was used to pierce the vertebra. Pus from this site was cultured several times for aerobic, anaerobic, acid-fast bacillus, and fungal stains, and a stat Gram stain was ordered. *Staphylococcus aureus* was identified as the infecting microbe. The patient was placed on nafcillin, 2 g, every 6 hours for 5 days, and a percutaneously inserted central catheter line was inserted for 6 weeks of home intravenous antibiotic therapy. There were no complications. Upon discharge, the patient was permitted full weightbearing as tolerated with a spinal hyperextension Jewitt orthosis (Florida Brace Co, Winter Park, FL). Physician follow-up evaluation was scheduled for week 3 postoperatively.

At 8 weeks after surgery, the patient was allowed to perform physical activity as tolerated, including sit-ups and jogging. No formal rehabilitation program was initiated. At 5 months, the patient was allowed to resume full checking and skating in hockey. He reported no complaints with skating activity, and his only concern was mild pain while rising from a seated position to a standing position. It was determined that this pain was due to pre-existing bilateral hamstring tightness and 5 months of limited physical activity. A routine of hamstring and low back musculature stretching and trunk musculature strengthening promptly relieved this pain.

DISCUSSION

Vertebral osteomyelitis, the most common form of hematogenously (blood-borne) acquired osteomyelitis in adults, is an uncommon cause of back pain but one that should be considered.[3] Osteomyelitis of the spine is rare, representing only 2% to 4% of all cases. Vertebral osteomyelitis occurs most

frequently in children ages 1 to 15 years and in adults ages 50 to 70 years.[2] More than 50% of cases involve persons over age 50, and the male:female ratio is 2:1.[3] Usually 2 vertebrae and a disc are involved;[2,4] occasionally only 1 vertebra is affected.[2] The lumbar spine is the most frequent site of spinal osteomyelitis (50% of all cases), and the most common area for spinal osteomyelitis is in the vertebral body.[2,3] In our patient, the infection occurred in the most anterior portion of the L3 vertebral body only.

Risk Factors

Risk factors for osteomyelitis include intravenous drug use, diabetes, and a history of bloodstream infections.[3] Spinal trauma, reported by 5% to 10% of patients, has not clearly been established as a predisposing factor.[3]

Vertebral osteomyelitis can arise from direct implantation of microbes as a result of trauma or surgery or from contiguous spread of infection at adjacent sites; it is most commonly a consequence of bacteremia or fungemia. Infections of, or procedures involving, the genitourinary tract are identified most often as the source.[2,3,5] Skin and soft tissue and respiratory tract infections are also common sources.[2,3]

Karpos et al[5] reported, from their review of cases of osteomyelitis of the pubis in athletes, that osteomyelitis of the pubis can occur in healthy individuals, with vigorous athletic activity as the only risk factor. They cited findings that outbreaks of staphylococcal disease have been reported in young adults engaged in vigorous physical activity; they mentioned, without reference, that, "experimentally, it is established that local trauma lowers the threshold for osteomyelitis."[5] From this, they hypothesized that activity-related microtrauma may predispose the pubis bone to bacterial seeding.[5]

Our patient had no apparent risk factors, other than being involved in vigorous athletic activity, and no history of remarkable trauma. Initially, the athletic trainer thought that his recurring streptococcal throat infections might have been associated; however, the infecting microbe identified was staphylococcus, not streptococcus. Similar to cases reviewed by Karpos et al,[5] no exact origin of microbe implantation could be determined. Although not confirmed, the cause in this case may have been the transport of a bacterial microbe through an unidentified skin lesion.

Diagnosis

Our patient had all the classic signs, symptoms, and diagnostic test findings for osteomyelitis. However in the early stages, with no risk factors, a lack of previous medical history, and no definitive cause, the diagnosis of osteomyelitis was elusive. With all the common physical findings related to mechanical back pain and with a recent bout of influenza, it is understandable that osteomyelitis was not initially suspected. Furthermore, the administration of ibuprofen and acetaminophen for influenza-like symptoms and the intermittent use of antibiotics for strep throat may have suppressed fever and pain and delayed the infection rate.

The presenting signs and symptoms of vertebral osteomyelitis vary considerably. Clinical features that suggest vertebral osteomyelitis in patients include subacute or chronic pain; history of bacteremia, fungemia, or spinal surgery; fever and chills or other constitutional symptoms; localized tenderness over the vertebral body; associated neurologic findings; elevated erythrocyte sedimentation rate; and distinctive diagnostic images.[2–6]

The presentation of lumbar vertebral osteomyelitis resembles that of lumbar dysfunction. Pain is the symptom most frequently associated with vertebral osteomyelitis, while paravertebral muscle spasm is the most frequent sign. Back pain is usually localized, constant, and unrelated to movement or position.[2,3] Other, less frequently noted signs include decreased hip range of motion, a hip held in flexion by the patient, localized tenderness, hamstring spasm, and generalized weakness. Pain may increase at night, and systemic back pain may increase with recumbent position.[2]

The most common laboratory abnormality is an elevated erythrocyte sedimentation rate. In 90% of cases, the rate is between 20 and 100 mm/h.[3] A review of the literature clearly points out that, although a high erythrocyte sedimentation rate is a common finding,[3,5–7] it alone cannot be used as the determining factor in diagnosing osteomyelitis.[3,7] Physical signs and symptoms, past medical history, and diagnostic imaging studies are all crucial for diagnosis.

Once vertebral osteomyelitis is suspected, diagnostic imaging is indicated.[3] Plain x-rays are routinely taken, but bone scans and MRIs are also commonly used.[2,3,5,6,8] On plain radiographs and tomograms, anteroposterior and lateral views of the spine demonstrate lesions compatible with vertebral osteomyelitis in up to 80% of patients at the time of presentation.[3] Localized bony changes of osteomyelitis usually develop 2 to 4 weeks after the onset of symptoms.[3,5,9] MRI, which has demonstrated sensitivity and specificity values exceeding 90%,[3] is the imaging test of choice in diagnosing vertebral osteomyelitis[3,4,7,8,10] and provides the soft tissue detail of computed tomography.[3] Computed tomography is the imaging study of choice for preoperative evaluation and for guiding needle biopsy procedures in patients with vertebral osteomyelitis because of its specificity.[3,4] Ultrasonography is a useful additional method for the diagnosis and assessment of osteomyelitis and its complications in children, without the need for radiation.[9,10]

In our patient, plain x-rays were unremarkable, but MRI showed an abnormal signal intensity on the weighted images of L3 (Figure). Differential diagnosis at this point was round cell tumor, such as leukemia or lymphoma, versus osteomyelitis. Tumors, fractures, and degenerative conditions are often considered in the differential diagnosis. In patients with other spinal diseases or a history of spinal surgery, interpretation of diagnostic imaging test results can be very difficult.[3] The

definitive diagnosis must, therefore, be established by other means. When the patient presents for evaluation, blood cultures should be obtained, especially if there is fever. Bone culture may be necessary if blood cultures are negative.[5] The identification and sensitivity of the infecting microbe is required for optimal pharmacologic treatment.[3,4] In about 25% of cases, the infecting microbe can be identified on blood cultures,[3] and needle biopsy yields a bacterial etiologic diagnosis in 60% to 90% of cases.[3] *S aureus* accounts for 40% to 60% of cases of vertebral osteomyelitis in reported series.[3,6] In about 30% of the cases, enteric Gram-negative bacilli are identified as the infecting microbes.[3] A variety of other bacterial and fungal pathogens have been identified in osteomyelitis, but they are only a small percentage of cases.[3]

Treatment

Medical therapy alone resolves most cases of vertebral osteomyelitis. Treatment includes high-dose intravenous antimicrobial therapy for 4 to 6 weeks; rest, with limitation of movement and analgesics as needed; and periodic evaluation for complications.[3,4,6] Most patients do not require surgical intervention. Orthopaedic physicians often perform the biopsy and address the need for drainage, débridement, decompression, or stabilization. Cord compression and spinal instability are the most common indications for surgical intervention.[3]

In our patient, immediate surgical drainage was needed. An open biopsy was used to obtain a specimen for culturing. A review of the literature revealed that surgical drainage, although an atypical course of treatment, has been shown to be a reliable way of eradicating the abscess when antibiotic treatment alone is not effective.[2–6,11]

Intravenous antibiotics (versus oral or no antibiotic therapy) are recommended as the most effective initial treatment for osteomyelitis;[2–6,11] however, surgical intervention may be needed in patients who do not respond appropriately.[4,5,11] Nafcillin is the suggested antibiotic in treating cases of *S aureus* infection.[3–6] The use of intravenous nafcillin in our patient was successful in treating the infection and allowing for normal bone healing without recurrence of infection after surgery.

Another type of antibiotic therapy for osteomyelitis is identified in the literature.[12] A biodegradable antibiotic implant has been developed and evaluated in a localized osteomyelitic rabbit model. The study results indicated that a biodegradable antibiotic bead implant may provide extended bacterial concentrations of antibiotics for the time needed to completely treat osteomyelitis.[12]

We used plain x-rays and physical examination to follow our patient and to determine the effectiveness of the treatment course. The erythrocyte sedimentation rate is often used to determine the efficacy and duration of treatment in pyogenic vertebral osteomyelitis.[7] However, in clinical studies, the erythrocyte sedimentation rate response to antibiotic treatment of osteomyelitis during the first month has not been shown to be a clear predictor of success. In addition, rates higher than at the time of diagnosis have been reported after 2 weeks of antibiotic therapy, but the patients went on to clinical cure without surgery.[7] It has been concluded that, although the erythrocyte sedimentation rate does correlate well with response to treatment as a general rule, care must be taken in interpreting a persistently elevated or even rising erythrocyte sedimentation rate as an isolated clinical finding.[7]

Return to Activity

Little information exists on time to return to sport, but ranges from 4.5 to 6 months have been reported.[2,5] Our patient was advised at discharge that a return to full activity might not be possible until 6 months after surgery. No formal rehabilitation was ordered, and he did return to normal activities 5 months postoperatively. In our review of the literature, we found a similar course of treatment in which a patient, 6 months after surgery, was able to return to previous levels of function in work and sporting activities without pain or complications.[2] Karpos et al[5] reported that their patient, a collegiate athlete, followed a graduated rehabilitation program for 6 months and returned to running activities in 4 months.

CONCLUSIONS

Although uncommon, vertebral osteomyelitis must be suspected in athletes with unexplained, acute back pain. Osteomyelitis is believed to arise from the direct implantation of microbes hematogenously transported from areas of preexisting subacute trauma. Those involved in the health care of athletes should be aware of this entity, as well as the aggressive diagnostic and treatment measures required. It is important for health care providers to obtain a thorough medical history, along with a comprehensive physical assessment, and to re-evaluate the mechanical etiology of lumbar pain when clinical symptoms warrant.

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A Standardized Protocol for the Initial Evaluation and Documentation of Mild Brain Injury

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Objective: To present a protocol for the initial assessment and documentation of mild brain injury, a protocol that is used within the Department of Physical Education at the United States Military Academy.

Background: Recently, much attention has been given to the assessment and management of mild brain injury by the sports medicine community. Although the classification of and management strategies for mild brain injury have been well disputed, most experts agree on the essentials of the sideline or initial evaluation. According to leading experts, if an athlete has experienced an episode of mild brain injury, the initial signs and symptoms, as well as the course of those signs and symptoms, should be documented.

Description: Although many athletic training texts formerly discussed techniques for evaluating an episode of mild brain injury, few present an objective protocol to follow. Our protocol includes 3 components. The first component is the initial evaluation, which incorporates serial observations during the first 20 minutes after injury, with neurologic checks every 5 minutes. The second component includes a take-home sheet for athletes not referred to a physician for further evaluation. The third part of the protocol is a 24-hour postinjury follow-up examination for any signs or symptoms of postconcussion syndrome. Finally, we present the indications for referral to a physician for further evaluation.

Clinical Advantages/Recommendations: Using a standard protocol to guide evaluation and to document the initial course of signs and symptoms after mild brain injury allows the sports medicine staff to make better management decisions. In addition, patient instructions and the course of follow-up evaluations can be improved if a standard protocol is employed. Our protocol has been developed to meet the needs both of athletes who are exposed to mild brain injury on a daily basis and of the certified athletic trainers who initially evaluate them; the protocol can be adapted to the individual needs of each athletic training setting.

Key Words: concussion, sideline, neurologic

Recently, much attention has been focused on mild brain injury (MBI) by the sports medicine community.[1,2] While many classification systems and management guidelines have been proposed and debated,[1–5] despite scant scientific evidence to support them,[2,3,6] most sports medicine professionals agree on the basic components of the initial postinjury evaluation.[7–12] In addition, although many of the texts used to teach assessment techniques to athletic training students discuss the components for evaluating MBI, none presents a protocol for assessment.[7–10,12] Having a protocol for the documentation of every episode of MBI is essential to both the subsequent management of each individual injury and the further understanding of head injuries in general. Recently, criteria were presented to determine who should be evaluated following an episode of MBI.[1] It was recommended that specific signs and symptoms should be documented in all instances where MBI is suspected.[1]

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Our purpose in writing this manuscript was twofold: 1) to present a protocol (employed successfully by the certified athletic trainers in the Department of Physical Education at the United States Military Academy [USMA]) for the initial evaluation and documentation of MBI, and 2) to discuss how the protocol is used to assess recovery at 24 hours postinjury in order to determine the appropriate management and medical follow-up after an episode of MBI.

The physical education program at USMA is distinctive. Each cadet is required to participate in at least 1 competitive sport (NCAA, competitive club, or intramural) per academic semester. Each cadet must also participate in at least 1 team contact sport during the course of study at USMA. Additionally, all cadets must complete a rigorous physical development program offered by the Department of Physical Education. On any given day, cadets are involved in activities (such as boxing, self-defense, football, soccer, rock climbing, and rugby) that place them at risk for MBI. Further, a cadet may be scheduled to participate in a physical education class involving boxing or grappling in

the morning and then in intramural football, rugby, or soccer in the afternoon. With the high number of exposures to MBI at USMA, it is essential that all cadets who are suspected of sustaining an injury be evaluated and excused from participation in all compulsory contact sports for a period of time.[2,13–15] Cadets are excused primarily due to the threat of further insult and second-impact syndrome.

Educating the Corps of Cadets at USMA with regard to the signs, symptoms, and possible complications associated with MBI is not part of the protocol we present in this manuscript. However, we mention it here because of the important role of MBI education in the prevention of MBI in general and in establishing the validity of our protocol, specifically in terms of self-reporting. Participants, coaches, and monitors working with high-risk contact sports at the club and intramural levels are educated regarding the signs and symptoms associated with MBI. In addition, athletes participating in sports such as boxing are educated about the signs and symptoms of postconcussion syndrome and the importance of seeking care before returning to contact sports, especially if such symptoms persist. We feel that this educational effort both increases the number of athletes who self-report with a minor "ding" and enhances our ability to ensure that all these athletes are evaluated and managed properly.

DEFINITION OF INJURY

When developing a protocol for the initial assessment and subsequent management of MBI, we needed an operational definition of what constitutes an episode or injury. We used the definition of MBI outlined in the "Executive Summary" of the *Mild Brain Injury in Sports Summit*, sponsored by the NATA Research & Education Foundation (REF) in 1994.[1] If any or all of the following conditions are present, the individual has a mild brain incident, and the specific signs and symptoms should be documented: a) The person is oriented yet presents with an altered mental state and/or loss of motor tone. b) The person is mentally unresponsive, ie, there is an inability to obey commands or directions. c) The person has evidence of posttraumatic amnesia as measured by the Galveston Orientation and Amnesia Test (GOAT). d) The person has evidence of "postconcussion symptoms," eg, headaches, nausea, dizziness, fatigability, or loss of concentration. e) The person reports or was observed to have had a loss of consciousness; it should be recorded as having been reported or directly observed.

ASSESSMENT PROTOCOL

As soon as it is determined that a subject has sustained an MBI, a 20-minute evaluation is initiated, which entails a number of serial observations, with neurologic checks every 5 minutes documented using a head injury evaluation sheet (Figure 1). Circling the Y next to each item on the evaluation sheet indicates abnormal findings, while circling the N indicates normal findings. Whether the subject's condition is improving or deteriorating is also indicated, documented, and compared with the initial or previous measurement by circling the appropriate arrow on the evaluation sheet. We use guidelines similar to those recommended by the Colorado Medical Society and the Quality Standards Subcommittee of the American Academy of Neurology.[1,3,15] While we recognize that these are only guidelines and that they are based on scant scientific evidence, we feel that they best meet our needs, since they are based on the limited existing literature on MBI.[3]

Regardless of whether or not signs and symptoms have resolved,[16] every subject who has sustained an MBI according to our definition is placed on a no-contact medical excusal for at least 5 days, given a take-home sheet (Figure 2), and instructed to report to the athletic training room the next day for a 24-hour follow-up evaluation. The take-home sheet comprises 2 parts. The first part is directions for the injured subject to follow. The second part is for the roommate, parents, or anyone who can monitor the injured subject for the next 24 hours. At the time of the 24-hour follow-up evaluation, the subject completes a questionnaire to determine whether signs and symptoms of postconcussion syndrome (PCS) are present (Figure 3). The questionnaire includes anchored 10-cm visual analog items to assess any symptoms. If subjects have no signs or symptoms of PCS at the time of the 24-hour follow-up evaluation, they are then advised to return to full participation at the end of the 5-day medical excusal. However, subjects are instructed to return to the athletic training room or the physician for further evaluation if they experience any further complications (similar to those covered in the questionnaire) before the end of their medical excusal. A subject who exhibits signs or symptoms of PCS at the 24-hour follow-up evaluation is referred to the health clinic for further evaluation, as outlined below. Additionally, cadets are instructed to return to the athletic training room at 48-hour intervals to be reassessed for symptoms of PCS until they are asymptomatic. If symptoms persist for a significant amount of time (longer than 1 week) or increase in frequency or intensity, the subject is referred back to the physician for further evaluation. Only after subjects are asymptomatic at rest and during exercise and have been excused from contact sports for an appropriate amount of time, depending on the duration of their signs and symptoms of PCS, are they permitted to return to full duty. Furthermore, any athlete who experiences PCS for any length of time must be cleared by a physician before returning to contact sports.

INDICATIONS FOR REFERRAL

A subject who presents with significant neurologic symptoms, such as prolonged loss of consciousness, is immediately transported to the hospital for further evaluation by a physician. Additionally, if at any time during the 20-minute evaluation the subject's symptoms deteriorate from the initial assessment (baseline evaluation) or the certified athletic trainer

Head Injury Evaluation Sheet

NAME	CO	CL	DATE
EVENT	PE	IM	MECHANISIM OF INJURY

GLASCOW COMA SCALE	
EYES(Open)	
Spontaneously	4
To Verbal Command	3
To Pain	2
No Response	1
BEST MOTOR RESPONSE	
Obeys Verbal Command	6
To Pain Stimulus	
Localizes Pain	5
Flexion Withdrawal	4
Flexion Abnormal	3
Extension	2
No Response	1
BEST VERBAL RESPONSE	
Oriented and Conversing	5
Disoriented and Conversing	4
Inappropriate Words	3
Incomprehensible Sounds	2
No Sounds	1

TIME_____

Palpate Neck	Y	N	↑	↓
Unconscious	Y	N	↑	↓
Dizzy	Y	N	↑	↓
Headache	Y	N	↑	↓
Nausea/Vomit	Y	N	↑	↓
PERL	Y	N	↑	↓
Tinnitus	Y	N	↑	↓
Amnesia	Y	N	↑	↓
Motor/Sensory	Y	N	↑	↓
Balance	Y	N	↑	↓
GCS	Y	N	↑	↓
Vision	Y	N	↑	↓

Initials _____ 0 MIN

TIME_____

Palpate Neck	Y	N	↑	↓
Unconscious	Y	N	↑	↓
Dizzy	Y	N	↑	↓
Headache	Y	N	↑	↓
Nausea/Vomit	Y	N	↑	↓
PERL	Y	N	↑	↓
Tinnitus	Y	N	↑	↓
Amnesia	Y	N	↑	↓
Motor/Sensory	Y	N	↑	↓
Balance	Y	N	↑	↓
GCS	Y	N	↑	↓
Vision	Y	N	↑	↓

Initials _____ 5 MIN

TIME _____

Palpate Neck	Y	N	↑	↓
Unconscious	Y	N	↑	↓
Dizzy	Y	N	↑	↓
Headache	Y	N	↑	↓
Nausea/Vomit	Y	N	↑	↓
PERL	Y	N	↑	↓
Tinnitus	Y	N	↑	↓
Amnesia	Y	N	↑	↓
Motor/Sensory	Y	N	↑	↓
Balance	Y	N	↑	↓
GCS	Y	N	↑	↓
Vision	Y	N	↑	↓

Initials _____ 10 MIN

TIME _____

Palpate Neck	Y	N	↑	↓
Unconscious	Y	N	↑	↓
Dizzy	Y	N	↑	↓
Headache	Y	N	↑	↓
Nausea/Vomit	Y	N	↑	↓
PERL	Y	N	↑	↓
Tinnitus	Y	N	↑	↓
Amnesia	Y	N	↑	↓
Motor/Sensory	Y	N	↑	↓
Balance	Y	N	↑	↓
GCS	Y	N	↑	↓
Vision	Y	N	↑	↓

Initials _____ 15 MIN

TIME _____

Palpate Neck	Y	N	↑	↓
Unconscious	Y	N	↑	↓
Dizzy	Y	N	↑	↓
Headache	Y	N	↑	↓
Nausea/Vomit	Y	N	↑	↓
PERL	Y	N	↑	↓
Tinnitus	Y	N	↑	↓
Amnesia	Y	N	↑	↓
Motor/Sensory	Y	N	↑	↓
Balance	Y	N	↑	↓
GCS	Y	N	↑	↓
Vision	Y	N	↑	↓

Initials _____ 20 MIN

COMMENTS:

Key: Y= abnormal N= normal
↑ = condition improving ↓= condition deteriorating

Post-concussion syndrome? Y N
Recheck date_____ Initial _____

TO ER TIME _____
NOTIFICATION:
COMPANY _____
DEP. DIR. _____
CHC _____
INSTRUCTOR _____

CLEARED TIME _____
HEAD SHEET ISSUED_____
4 DAY EXCUSAL ISSUED _____
POST THIS SHEET FOR FOLLOW-UP _____

Figure 1. Head injury evaluation sheet to document the presence and course of the initial signs and symptoms after an episode of mild brain injury.

DEPARTMENT OF THE ARMY
UNITED STATES MILITARY ACADEMY
West Point, New York 10996

REPLY TO
ATTENTION OF

MACC-P 12 March, 1998

MEMORANDUM FOR CADETS WITH HEAD INJURIES

SUBJECT: Suspected Head Injuries

1. Cadets with suspected head injuries will adhere to the guidance in this memorandum. Follow the instructions below and give the bottom half of this sheet to your roommate or other personnel who will be with you for the next 24 hours.

   a. Do NOT take any aspirin or other pain medication.

   b. If your headache worsens go to the Keller Emergency Room (ER).

   c. If you get nauseous, dizzy or have memory loss, have someone call the Keller ER (938-4004).

   d. Do not participate in contact sports for four days from the injury.

   e. Report to the DPE Training Room on _____.

---

2. Cadets with suspected head injuries will give this portion to your roommate or to any person who will be with you over the next 24 hours.

   a. _____ sustained a mild head injury on _____ while participating in _____.

   b. Please pay close attention to the cadet for development of these signs and/or symptoms:

(1) Unequal pupils	(6) Vomiting or nausea	(11) Unconsciousness
(2) Worsening headaches	(7) Unsteadiness on feet	(12) Poor light accommodation
(3) Drowsiness	(8) Ringing in ears	(13) Blurred vision
(4) Slurring of speech	(9) Memory loss	(14) Convulsions
(5) Incoordination	(10) Difficulty in waking	

3. If these conditions arise, please bring the cadet to the hospital immediately or call for the ambulance (938-4004). Inform them of the situation and provide the cadet's exact location. During or while awaiting transport, keep the cadet warm, lying down and quiet. Do not give the cadet aspirin or any other pain medication without a doctor's approval.

4. If you have any questions about the injury, please contact the Hospital ER (938-4004) or the DPE Training Room (938-2352).

J.A. CARUSO
MAJ, AG
DPE, Admin Officer

Figure 2. Take-home sheet for athletes who are not referred for further evaluation by a physician, containing instructions for the patient and the person who will monitor the patient for the first 24 hours postinjury.

DPE Sports Medicine
Mild Brain Injury PCS Questionnaire

Last Name	First Name	CO	Year	SSN#	Date

Please answer the following questions regarding any signs or symptoms that you may have experienced since the day after your initial injury or since your previous evaluation. Please take the time to read all questions thoroughly.

1. Do you, or have you had any of the following signs:

Intolerance of bright lights or difficulty focusing vision	Y	N
Poor attention and concentration	Y	N
Persistent or intermittent headache	Y	N
Nausea/vomiting	Y	N
Easy fatiguability	Y	N
Irritability or low frustration tolerance	Y	N
Intolerance of loud noises or ringing in the ears	Y	N
Excessive anxiety or abnormal mood swings	Y	N
Dizzyness or light-headedness	Y	N
Abnormal difficulty sleeping	Y	N

2. Are you experiencing any abnormal difficulty concentrating while reading, writing, listening to lecture, or carrying on a conversation? Y N

If you answered yes, please place a vertical line in the box below indicating where your symptoms are along the continuum.

Totally unable to concentrate No difficulty concentrating

3. Are you experiencing any abnormal difficulty remembering familiar names, phone numbers, social security numbers, or historical names or events? Y N

If you answered yes, please place a vertical line in the box below indicating where your memory is along the continuum.

Total memory loss Normal memory

4. Are you experiencing any abnormal difficulty remembering newly acquired information?
Y N

If you answered yes, please place a vertical line in the box below indicating the frequency that you are having difficulty remembering newly acquired information.

Never Always

Continued on Reverse

Figure 3. Postconcussion symptom assessment questionnaire to evaluate the state of postconcussive symptoms at the 24-hour follow-up evaluation and any subsequent follow-up evaluations.

5. Do you feel abnormally run down and or tired since your injury? Y N

If you answered yes, please place a vertical line in the box below indicating the frequency that you are feeling abnormally tired.

Never Always

6. Are you experiencing any abnormal mood swings? Y N

If you answered yes, please place a vertical line in the box below indicating the frequency that you are experiencing abnormal mood swings.

Never Always

7. Are you experiencing or have you experienced any other abnormal signs or symptoms since your previous evaluation? Y N

If you answered yes, please list any additional symptoms that you have been experiencing since your injury.

8.Overall are you currently feeling normal? Y N

If you answered no, please place a vertical line in the box below indicating how you feel overall along the continuum.

Incapacitated Normal

9. If you are currently feeling normal when did your signs and symptoms completely resolve?

Date:_____ Time:_____ AM/PM

COMMENTS:

suspects that a more significant brain injury may be present, the subject is transported to the hospital for further evaluation. If, at the completion of the 20-minute evaluation, subjects are still experiencing more than a mild-to-moderate headache, they are either referred to the health clinic for further evaluation or transported to the hospital, depending on their condition. Finally, if subjects present with signs and symptoms of PCS at the 24-hour follow-up evaluation, or if symptoms persist as outlined previously, they are referred to the health clinic for further evaluation by a physician.

DISCUSSION

Proper documentation and initial assessment of any episode of MBI are essential to the subsequent management of each individual injury.[1] Having a standardized protocol for assessment and documentation of the injury makes these tasks easier for the certified athletic trainer and the sports medicine team. Our protocol is based on the existing literature dealing with the neurologic signs and symptoms associated with sport-induced MBI. It should be noted that, as with any protocol, our procedures should be updated as new research findings become

Special Tests for Signs and Symptoms Associated with Mild Brain Injury

Sign or Symptom	Special Test	Description
Amnesia	GOAT	10-item orientation questionnaire
Information processing	100-7 test	Ask the subject to count backward by 7s from 100
	Months in reverse	Ask the subject to recite the months in reverse order
Balance	Romberg test	Athlete maintains proper posture with feet together, arms at side, and eyes closed
Motor and sensory function	Dermatomes	Assess upper and lower extremity function
	Myotomes	Assess upper and lower extremity function
	Finger to nose	With eyes closed, athlete touches nose with index finger
	Heel-to-toe gait	Athlete walks heel to toe
	Heel to knee	Athlete touches knee with opposite heel while supine

available. Our protocol can also be adapted to meet the individual needs of each athletic trainer or sports medicine program. This protocol has been approved by the general surgeons at Keller Army Community Hospital, USMA, West Point, NY, and is recognized as our standard operating procedure with regard to the initial assessment and evaluation of MBI. As with any procedure or protocol, the specifics should be discussed and coordinated with a team physician.

Recently, a Standardized Assessment of Concussion (SAC) instrument was developed to evaluate neurocognitive decrements associated with MBI.[17] This instrument focuses on assessing impaired concentration and attention, along with mild disorientation and memory deficits. Although the SAC may be a valuable objective tool to assist in the initial evaluation of MBI, it fails to identify and document the progression of neurologic signs and symptoms associated with each individual injury.[17] However, if the SAC were administered at the completion of the 20-minute initial evaluation presented in this manuscript or any other similar evaluation, the clinician would have both neurocognitive and neurologic postinjury information to assist in management decisions. Although the SAC may serve as a beneficial component of the initial assessment battery of MBI, the sensitivity of the SAC has not been established. Further research is needed to determine its effectiveness.

While education about the signs and symptoms associated with MBI is not part of our protocol, we have seen that it is important in obtaining a high self-reporting rate after any episode of MBI. Furthermore, education about the potential side effects of returning to contact sports while still symptomatic, or even shortly after becoming asymptomatic, may aid in preventing potentially catastrophic injuries.[18,19] Educational efforts such as the "HEADS UP!" program[20] may aid in educating not only athletes but also parents, coaches, physicians, and others who may be unfamiliar with the sequelae of MBI.

Terminology is an important component of any injury assessment protocol. Our protocol uses the definition of MBI outlined in the "Executive Summary" of the *Mild Brain Injury in Sports Summit* sponsored by the NATA-REF.[1] While several definitions of concussion and MBI exist,[1,18,21–23] we feel that this definition of MBI is one of the most current and thorough to date. Additionally, we feel that this definition is broad enough to ensure that all potential episodes of MBI are evaluated and documented by our staff.

Our protocol comprises 3 parts: the initial 20-minute assessment, the take-home sheet, and the 24-hour follow-up for signs and symptoms of PCS. The initial assessment is critical, because every brain injury has the potential to be catastrophic. Therefore, the initial evaluation should last for at least 15–20 minutes postinjury.[1,3,11] Most of the serial observations and neurologic checks that are performed at each 5-minute interval during the initial 20-minute evaluation (level of consciousness, dizziness, headache, nausea, etc) are assessed either by subjective questioning or observation. While some authors have questioned the validity of subjectively assessing the signs and symptoms associated with MBI,[21] we feel that these techniques are effective and valid for our population. This can be attributed to our educational efforts, as well as the fact that our subjects are held to a strict honor code, which they can be expelled for violating. While this is not the norm in other institutions, it assists us in maintaining a high rate of compliance. Other items, such as amnesia, information processing, balance, and motor and sensory function, can be assessed in several different ways, a few of which are listed in the Table. The specifics regarding which special tests are appropriate should be determined on an individual basis, depending on the patient's status and clinical presentation.

The use of a take-home sheet with instructions for care, management, and follow-up after an episode of MBI is not a new concept.[11,23] While the validity and reliability of such instruction sheets have been questioned,[24,25] we have observed excellent compliance. Although this could be attributed to the population with which we work, we believe that our success is partially due to the nature of the information included in our sheet, along with the verbal reinforcement of that information before the subject is discharged. Our take-home sheet includes two parts. The first section is for the patient and outlines the indications for seeking further medical care, what the patient should or should not do until the 24-hour follow-up evaluation, and the date of the 24-hour follow-up evaluation. The second section is for the patient's roommate or at-home observer and outlines what happened and what signs and symptoms to look for that might indicate the need for further medical treatment.

PCS is not an uncommon sequela after MBI.[26] Even more important for the sports medicine professional, returning an

athlete to contact activity while signs and symptoms of PCS are still present may result in a catastrophic outcome.[2,4,16] Therefore, it is essential to have a predetermined schedule for follow-up evaluation after an episode of MBI. Our protocol incorporates a 24-hour follow-up evaluation to assess for signs and symptoms of PCS, at which time the subject completes a questionnaire regarding the presence of any signs and symptoms of PCS. A certified athletic trainer evaluates the questionnaire and follows up with verbal questions about the responses given. While a scale has been proposed to measure the severity of PCS, the reliability and validity of that tool remain questionable.[26] The main purpose of our questionnaire is to obtain and document subjective and objective data about the patient's status with regard to signs and symptoms of PCS. The most frequent complaints associated with PCS include headache, fatigability, and dizziness.[26] Incorporating a questionnaire and a predetermined follow-up schedule to assess for signs and symptoms of PCS is a valuable part of any protocol to assess the course of MBI.

CONCLUSIONS

Our protocol is one that has been successfully used by the certified athletic trainers in the Department of Physical Education at USMA. This protocol has evolved and been employed over the last 10 years, which has allowed the certified athletic trainers to identify suspected head injuries and maintain 100% accountability for the nearly 200 episodes of MBI that have been managed annually in our setting. Furthermore, although we currently have no hard data to support our theory, we believe that the recurrence rate of MBI upon return to physical activity has been minimized as a result of this protocol and our associated approach to injury management. Using a standard protocol to guide the initial assessment and document the initial course of signs and symptoms associated with an episode of MBI has allowed our staff to make better management decisions. In addition, concentrating on the initial signs and symptoms and their course may be more important in determining the course of management than focusing on the grade of the injury.[13] Although our protocol is used in an environment where control over the patients is greater than is generally available, we feel it can be adapted to meet the needs of certified athletic trainers and sports medicine professionals who are tasked with evaluating MBI on a regular basis, regardless of their setting.

It should be noted that our protocol serves only as a guide to the evaluation and documentation of the initial signs and symptoms of MBI. Moreover, this protocol is not all-inclusive, and the clinician should not feel bound to any protocol, especially if the signs and symptoms of an individual case dictate that another course of management is prudent.

More valid and reliable objective tests for the initial assessment of MBI are needed. Such instruments should accurately assess the duration and intensity of lasting neurophysiologic and neuropsychologic impairments after MBI. As these tools become available, they should be incorporated into any assessment protocol. Finally, as quality research findings become available, they should also be incorporated into the current protocol as appropriate.

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We acknowledge all the certified athletic trainers who have served in the Department of Physical Education at USMA throughout the years. Further, we recognize those certified athletic trainers for their contributions to the continued development of the protocol presented in this manuscript.

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Modifications to the Standard Sit-and-Reach Flexibility Protocol

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Objective: To present several modifications of the standard sit-and-reach protocol.

Background: Many exercises designed to increase strength and aerobic capacity tend to decrease the flexibility of the erector spinae and hamstrings musculature. Less-than-ideal flexibility in these soft tissues may increase the risk of injury during training, competition, or activities of daily living. The most widely used measures of flexibility have been either the stand-and-reach or the sit-and-reach, but both are limited to a single measure.

Description: Using the new multitest flexometer, we were able to take 6 flexibility measures beyond the stand-and-reach test: standard active sit-and-reach, standard passive sit-and-reach, modified active sit-and-reach with external rotators slackened, modified passive sit-and-reach with external rotators slackened, modified active sit-and-reach with the hamstrings, gastrocnemii, and external rotators slackened, and modified passive sit-and-reach with the hamstrings, gastrocnemii, and external rotators slackened.

Clinical Advantages: This modified sit-and-reach protocol allows the indirect assessment of the influence of the 4 major muscle groups that affect sit-and-reach scores: erector spinae, hip rotators, hamstrings, and gastrocnemii.

Key Words: assessment, fitness testing, stretching

It is generally accepted that there are several components to health-related or sport-specific fitness and that the significance of each component varies depending on the activity or sport involved. In recent years, individuals wanting to promote health and well-being have focused on aerobic fitness and strength development, whereas those pursuing excellence in sport focus on all aspects of training. When practiced intelligently, strength and aerobic conditioning result in marked improvements in these fitness parameters. However, many exercises designed to increase strength and aerobic capacity tend to reduce the flexibility of the erector spinae and hamstrings musculature.[1] Less-than-ideal flexibility in these soft tissues may increase the likelihood of injury during a training session, competition, or participation in daily physical activities.[2,3]

RATIONALE FOR MODIFICATIONS

Testing the combined flexibility of the erector spinae and hamstrings musculature has been an integral part of fitness and sport assessment for many decades. The most common and widely used measure of flexibility has been the sit-and-reach test. This technique has been used extensively in exercise science laboratories, physical education classes, and commercial fitness centers. In these settings, the typical device used to test this parameter is a flexometer, which is an apparatus that indirectly tests flexibility; many versions have been developed. Most involve a sit-and-reach box with a long scale attached at the top. The scale is marked off in centimeters and inches. A sliding block is attached to the scale, which is pushed by the athlete being tested. Experts agree that both stand-and-reach[4] and sit-and-reach[5] tests have been used extensively as indirect measures to simultaneously assess hamstring and low back flexibility. Each has advantages and disadvantages.

It is interesting to note that the literature does not contain information about the influence on sit-and-reach of either the gastrocnemii or the external rotators of the hip. Laboratory evaluations of kinesiology students and human cadavers have confirmed the influence of other muscle groups.[6] For example, scores using the stand-and-reach are more highly correlated with the Leighton flexometer than are scores using the sit-and-reach.[7] However, while in the sitting position, the performer is able to maintain full extension of the knees and cannot tilt or rotate the pelvis.[8] It has been suggested that scores obtained from both the stand-and-reach and the sit-and-reach are confounded by trunk and limb lengths.[9,10] Broer and Galles[9] have questioned the validity of the sit-and-reach test, suggesting that there is an advantage for an individual with a long trunk, long arms, and short legs. However, a recent study has not confirmed this claim.[1] Both standard techniques (stand-and-reach and sit-and-reach) are limited to a single measure. Neither has an established protocol that allows the measurement of passive range of motion (ROM), nor do they permit a separate assessment of the 4 muscle groups involved.

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With the above in mind, our purpose was to present several modifications of the standard sit-and-reach protocol that permit an indirect assessment of the influence of the 4 major muscle groups that affect sit-and-reach scores.

DESCRIPTION OF DEVICE

In an attempt to indirectly assess the influence of the 4 major muscle groups that affect sit-and-reach scores, a new device called the multitest flexometer (MTF) and several new protocols have been developed. The MTF consists of a foot-support platform, frame, and measuring device. The feet of the subject are placed on (stand-and-reach) (Figure 1) or against (sit-and-reach) the foot-support platform during testing. The foot-support platform is a standard steel plate. The frame of the MTF is constructed of welded beams of steel and can be fastened to the floor via 4 suction cups. The MTF is unique in that it needs no modifications to prepare it for any of the testing procedures. Two customized steel hinge joints allow the MTF to pivot into either the stand-and-reach or sit-and-reach testing position.

The measuring platform is a standard steel plate supporting 2 scales (metric and British). A block moves easily along the length of the scales and permits easy readings of obtained scores. The overall weight of the MTF is less than 15 kg (approximately 30 lb), and it is easy to transport. A board that fastens to the MTF is included for subjects to sit on. The board also has a linear scale in order to record the position of the coccyx during the long-sitting position and the position for tests in which the subject moves toward the platform.

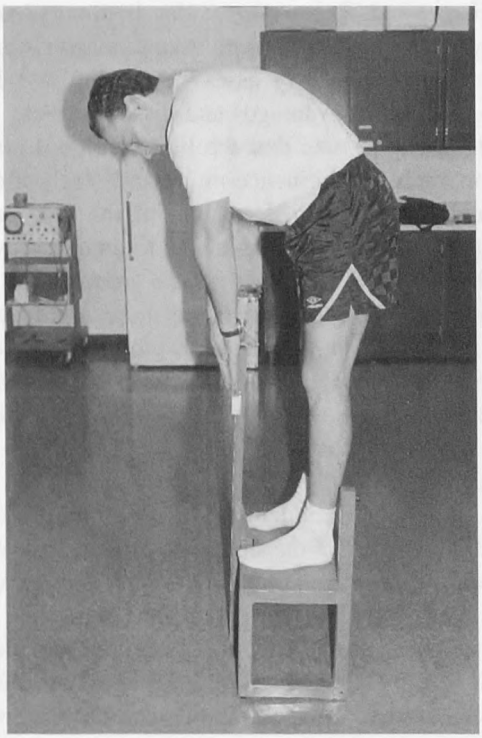

Figure 1. The MTF in the stand-and-reach position while the subject performs an active stretch.

DESCRIPTION OF TESTS

Both the stand-and-reach and the sit-and-reach tests are designed to measure the ROM of the muscle and connective tissue structures involved in these movements. All tests involve a slow, gradual flexion of the lumbar and thoracic regions of the trunk. There is some anterior pelvic tilt, full scapular elevation, and upward rotation, flexion, and horizontal adduction of both shoulder joints with the elbows, wrists, and fingers extended.

The MTF allows for 6 additional flexibility measures beyond the standard or typical stand-and-reach test: 1) standard active sit-and-reach, with gastrocnemii, hamstrings, external rotators of the hips, and erector spinae in lengthened position (SRa; Figure 2A); 2) standard passive sit-and-reach, as above, with an external force added (90 N used in our studies) (SRp; Figure 2B); 3) modified active sit-and-reach with external rotators slackened (MSR^1a; Figure 2C); 4) modified passive sit-and-reach with external rotators slackened (MSR^1p; Figure 2D); 5) modified active sit-and-reach with the hamstrings, gastrocnemii, and external rotators slackened (MSR^2a; Figure 2E); and 6) modified passive sit-and-reach with the hamstrings, gastrocnemii, and external rotators slackened (MSR^2p; Figure 2F).

SRa

The subject assumes a long-sitting position on the board. The subject keeps the knees fully extended and feet dorsiflexed and positioned flat against the foot-support platform. The sitting distance (position of coccyx) from the MTF is recorded (Figure 3). The toes are even with the front edge of the foot-support platform. The fingertips are placed together, one on top of the other and adjacent to the block that lies along the scale. The subject begins the test by slowly and concentrically contracting the hip flexors and abdominals, bringing the body to the pain-free limit through slow, active concentric contractions. The final position is held with an isometric contraction (2 seconds), and the measurement is taken (the score is the point reached by that part of the block touching the fingers at the completion of movement). During this process, the posterior trunk and posterior shoulder girdle musculature are slowly lengthened, while the knees remain fully extended. The subject's hands move the block along the scale until the movement is terminated because the subject can go no farther.

SRp

During the SRp test, a gentle external force is applied by the instructor. This assistance is provided through a tensiometer attached to a nylon rope grasped in the hands of the subject. The force is applied when the subject reaches the end of his or her maximum active range. Depending on the size and condition of the person being tested, 90 N may be used. The tensiometer is held by the instructor, who initiates a low-intensity pull on the tensiometer along the plane of the

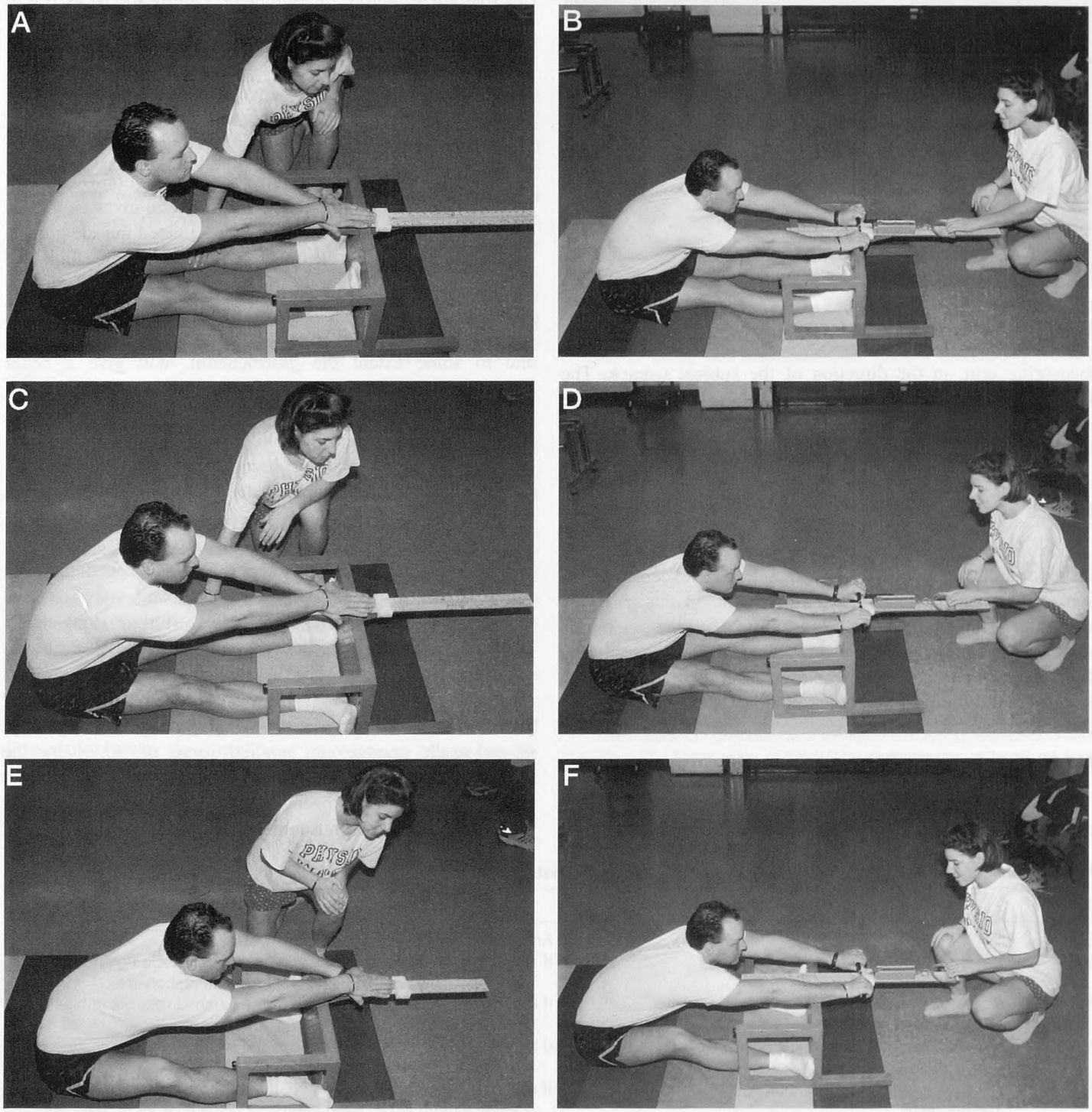

Figure 2. A, The multitest flexometer (MTF) in the sit-and-reach position while the subject performs an active stretch (SRa). B, The MTF in the sit-and-reach position while the subject is assisted in performing a passive stretch (SRp). C, The MTF in the sit-and-reach position while the subject performs an active stretch with the external rotators slackened (MSR^1a). D, The MTF in the sit-and-reach position while the subject is assisted in performing a passive stretch with the external rotators slackened (MSR^1p). E, The MTF in the sit-and-reach position while the subject performs an active stretch with the hamstrings, gastrocnemii, and external rotators slackened (MSR^2a). F, The MTF in the sit-and-reach position while the subject is assisted in performing a passive sit-and-reach with the hamstrings, gastrocnemii, and external rotators slackened (MSR^2p).

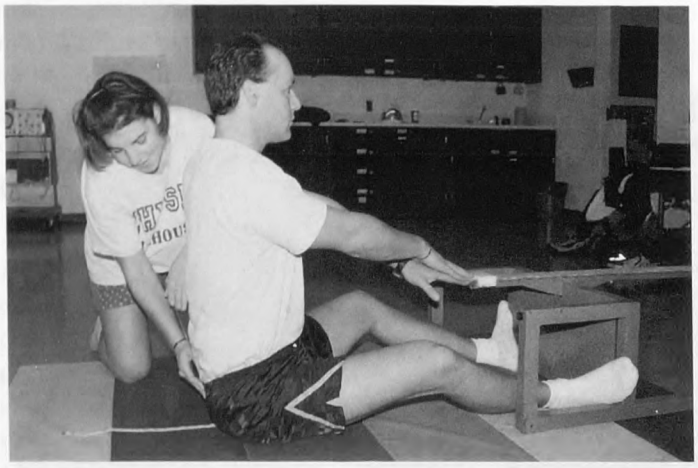

Figure 3. Instructor measuring the distance during reposition in the MSR^2 test. Note the landmark (coccyx) and the floor scale.

measuring arm, in the direction of the subject's reach. The instructor initiates a slow build-up to 90 N of force or until the subject experiences any degree of discomfort. If discomfort is felt by the subject, tension is immediately decreased.

MSR^{1}a

The subject initially performs a slow, active sit-and-reach forward stretch, identical to that of the SRa, except that the subject has made a lower limb adjustment. In this case, the subject externally rotates both hip joints. After the position is assumed, normal test procedure is followed. When measuring MSR^{1}p, the same procedures as above (ie, MSR^{1}a) are used, with the addition of the external application of forces.

MSR^{2}a

In the MSR^{2}a, the same procedures for standard active and passive measurements are followed. However, from the standard straight-leg, sit-and-reach position, subjects externally rotate and flex both hip joints and flex the knees to 145° (internal angle) before measurement. During the MSR^{2}p test, the subject is positioned in the identical posture with the same movement as in the SRp and MSR^{1}p tests. A gradual force is applied during the test. The instructor must measure the position of the coccyx at the long-sitting position on the floor scale provided with the flexometer. That distance is subtracted from the scores on the 2 final measures to account for the moving up of the body to assume the test position (Figure 3).

SRa is the standard flexibility measure and gives an indication of the combined effects of all investigated muscle groups. Tightness in any or all may contribute to the limits of movements. MSR^{1}a allows the testing of forward flexion without the undue influence of the external rotators of the hips. MSR^{2}a, by "slackening" the external rotators and hamstrings and to some extent the gastrocnemii, will give a better indication of the erector spinae group's elasticity.

These positional changes help to isolate the relative contributions to sit-and-reach flexibility measurements of the back musculature, hip rotators, hamstrings, and gastrocnemii (Table). Since the feet are both dorsiflexed and the knees are extended, the gastrocnemii provide some limitation in the SRa, SRp, MSR^{1}a, and MSR^{1}p tests. In the MSR^{2}a and MSR^{2}p tests, the hamstrings and gastrocnemii are slackened and have less influence on these measures. A standard active sit-and-reach is done with the legs completely straight (long-sitting position). The difference between active and passive sit-and-reach is the final trunk-flexion position. (Trunk flexion as measured in SR and derivatives does involve some anterior pelvic tilt via movement at the lumbosacral joint.) A passive sit-and-reach involves an applied force of 90 N by the instructor while the subject performs the sit-and-reach. The instructor pulls the subject via a hand grip-to-scale-to-hand grip hook-up (cable tensiometer). The SRp, MSR^{1}p, and

Musculoskeletal Limitations to ROM* During the Sit-and-Reach Tests

Test†	Muscle Groups Assessed	Interpretation‡
SRa	All 4	Any or all of the 4 groups can limit ROM achieved.
SRp	All 4	If external force results in some improvement, muscle tightness, rather than abdominal and hip flexor weakness, is responsible.
MSR^{1}a	Release of external rotators	If improvement is noted, tightness of the external rotators of hips would have been a limiting factor in SRa.
MSR^{1}p	Release of external rotators	If improvement is noted, tightness of the external rotators of hips would have been a limiting factor in SRp.
MSR^{2}a	Release of external rotators, hamstrings, and gastrocnemii	If significant improvement is noted, the hamstrings (and gastrocnemii to a lesser extent) would have been a significant factor in SRa, SRp, MSR^{1}a, and MSR^{1}p.
MSR^{2}p	Release of external rotators, hamstrings, and gastrocnemii	If significant improvement is noted, the hamstrings (and gastrocnemii to a lesser extent) would have been a significant factor in SRa, SRp, MSR^{1}a, and MSR^{1}p.

* ROM, range of motion.

† SRa, Standard active sit-and-reach test; SRp, standard passive sit-and-reach test; MSR^{1}a, modified active sit-and-reach test with external rotators slackened; MSR^{1}p, modified passive sit-and-reach test with external rotators slackened; MSR^{2}a, modified active sit-and-reach test with the hamstrings, gastrocnemii, and external rotators slackened; MSR^{2}p, modified passive sit-and-reach test with the hamstrings, gastrocnemii, and external rotators slackened.

‡ Soft tissue contact between the abdomen and thighs can limit ROM. However, the interpretation given assumes no such contact.

MSR^{2}p tests are used only when passive measures are needed. The indications and precautions (eg, pain and involuntary muscle guarding) regarding passive stretching must be considered on an individual basis before application of this technique. Correct positioning of the athlete and instructor and proper execution of the stretch must be strictly followed.

There are several advantages with regard to testing flexibility with the MTF and the proposed sit-and-reach modifications: 1) the MTF is a simple apparatus to build; 2) it is simple to administer the test and view the scores; 3) it is simple for the athlete to follow instructions; 4) many athletes can be tested in a short period of time; and 5) normative data exist for the standard sit-and-reach and can be developed for all these modifications. The disadvantages include the following: 1) it is an indirect test; 2) anthropometric proportions of the athlete can greatly influence the results; and 3) the test is neither joint specific nor as accurate as other devices (eg, Leighton goniometer).

We are currently testing the MTF with a variety of individuals, from elite athletes and dancers to the elderly. To this point, our subjects have found the apparatus easy to use, and we have found the information from the tests useful. However, all testing should be supervised, and all passive testing should be administered by a qualified instructor only to those individuals without contraindications. With the MTF, both the conventional stand-and-reach and sit-and-reach can be self-administered, and standard norms for all age groups and both sexes can be used for comparisons. The tests are safe and can be performed in a short period of time.

The sit-and-reach test and its modifications can be used by the athletic trainer as an objective ROM assessment tool for specific muscle groups. The passive modifications can add information about the mobility of inert tissues that is specifically related to the function of the sit-and-reach test. In addition, it can assist the athletic trainer in determining whether manual therapy, soft tissue mobilization, or joint mobilization are appropriate therapeutic requirements to increase mobility and, if so, which techniques would be most beneficial (eg, muscle energy, active exercise, passive stretch, or massage).

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Athletic Training Education Programs: To Rank or Not To Rank?

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Objective: To discuss the literature regarding educational program ranking and to provide insights concerning undergraduate and graduate athletic training education ranking systems.

Background: The demand for accountability and the need to evaluate the quality of educational programs have led to program ranking in many academic disciplines. As athletic training becomes more recognized within the medical community, determining a program's quality will become increasingly important.

Description: We describe program rankings used in other disciplines for determining quality and providing measures of accountability. We discuss the strengths and weaknesses of both subjective and objective ranking systems, as well as the arguments for using program rankings in athletic training. Future directions for program ranking and potential research questions are suggested.

Applications: Ranking systems on the basis of levels of perceived quality and academic productivity of programs that prepare future professionals will help potential undergraduate and graduate students make informed decisions when selecting an educational program.

Key Words: graduate program ranking, undergraduate program ranking, prestige ranking, productivity ranking

Although future athletic training students will investigate whether a particular program is accredited or not, they may also wish answers to additional questions, such as whether programs have a good reputation and a productive faculty and whether they produce quality students. While these types of questions and a public demand for accountability in higher education have led to the popularization of ranking systems in other academic disciplines, athletic training has yet to rank programs for evaluation purposes. We posit, however, that, as athletic training continues to grow and employment opportunities become more competitive,[1] issues of program prestige and ranking will become increasingly important. Thus, our purpose in examining the literature base of program ranking was to draw reasonable conclusions about how the process relates to evaluating the prestige, quality, and effectiveness of athletic training education programs. In so doing, we attempted the following: to review the advantages and disadvantages of academic program ranking, to express caveats concerning ranking, and to provide future directions for program ranking research in athletic training.

ACADEMIC PROGRAM RANKING AND PRESTIGE

Political leaders in most states are examining how well institutions of higher education are preparing students.[2] This demand for accountability in higher education has led to the popularization of ranking systems in many academic disciplines (eg, anthropology, biosciences, physical education, psychology, and sociology) to evaluate the quality of undergraduate and graduate programs.[3] Faculty peers, administrators, or objective "experts" in the field are asked to volunteer an opinion regarding which program is first in quality, which is second, etc. These rankings can be categorized as either subjective or objective measures.

When program or faculty rankings are discussed, the fact that such rankings are subjective assessments (perceived quality) rather than objective assessments (real quality) is often argued.[4] Programs are usually subjectively assessed in terms of measures of perceived program quality or perceived faculty quality, or both.[5–10] Faculties and programs are usually objectively assessed in terms of productivity, using such measures as research presentations, published articles and textbooks, and citation counts of published works.[7,11–17]

REPUTATIONAL PROGRAM RANKING

Many educators have argued that reputational rankings are merely a collection of subjective opinions that are nothing more than rumor and gossip. Yet, reputational ranking continues to be the most popular form of rating methodology and is consistently used in the most prominent rankings studies that have been published.[4,7,9,10,18]

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The quality of universities or departments is an elusive notion that defies measurement.[4,6,9] Therefore, in higher education, perceived quality and prestige are highly related and are often used interchangeably.[4,6] Berelson[6] stated that quality is largely a matter of what the field recognizes as such. Massengale[4] further stated that perceived quality, not real quality, often determines who is offered a faculty position, awarded a position on the editorial board of a certain journal, nominated for an award, or selected as a reference.

The strength of subjective reputational rankings is that they produce results containing more face validity than other available rating methods,[4,8,18–20] because they are based on the opinions of experts. Although their judgments are subjective, to belittle their opinions is to belittle their expertise and their professional status.[4] Among the weaknesses of such rankings are that they are susceptible to the biases of raters, that they perpetuate the halo effect, and that they cater to the "good old boys" network.[4,12] The halo effect refers to an advantage enjoyed by faculty or departments affiliated with an institution that has an overall highly prestigious reputation.[4] Roose and Anderson[10] found that, although it was possible to produce data that appear to result from the halo effect, it was not uncommon for individual departments to be ranked lower than their affiliated institutions. Webster[18] supported Roose and Anderson's findings by reporting department rankings that greatly exceeded or fell short of their institutions' overall reputations.

Two other weaknesses of reputational rankings are that they effectively rank only departments employing faculty who possess substantial research and publication reputations, and, once rankings fall below the top 10 or 20 departments, it becomes extremely difficult to differentiate among those departments.[4,9,21]

PRODUCTIVITY RANKING

The advantage of objective rankings based on measures of faculty productivity is that they reduce these types of subjective biases. A disadvantage of objective rankings, however, is that they may not be the most valid measures of academic quality.[4,8,12,17] Cartter[7] has suggested that objective measures may not be objective at all; rather, they are subjective measures once removed. Cartter asserted that they are likely the result of examining or tallying items that were themselves originally issued largely on the basis of someone's subjective judgment.

Lag time, or the belief that rankings lag years behind reality or actual situations, is another frequently raised issue in ranking studies.[4] Webster[18] stated that lag time is most prevalent at the new PhD or junior-faculty level, because these individuals have not had enough time to make any impact on their departments' reputations. Massengale and Sage[9] stated that this merely dates the information but does not render it invalid. Putting it more directly, lag time is not a major problem because academic quality does not change abruptly anyway.[4,6]

THE EFFECTS OF PROGRAM RANKING

Program ranking plays an important role in American higher education, since it has the propensity not only to affect programs but also to affect students. From a programmatic standpoint, rankings serve as a measure of prestige, and prestige affects the survival of academic programs.[8] For example, less prestigious departments typically suffer the most severe budget and personnel cuts, because they are perceived to possess less quality than their peer units nationwide.[8] From a student's standpoint, it is generally accepted that, because top-rated graduate institutions have more distinguished faculties, they attract better students, who are able to associate with a better group of peers.[6] This association in itself provides both motivation and education that is often absent at lower-ranked schools.

Another example of the consequential nature of prestige hierarchies is the positive correlation between prestige ranks of departments where individuals obtain their doctoral degrees and the prestige rank of the departments that recruit them as faculty members.[4,8,22] Researchers working in the fields of anthropology,[23] biosciences,[24] physical education,[9] psychology,[11,25] and sociology[5,15,17,26–30] have found that, unless one receives a doctorate from a prestigious university, there is very little chance of ever being offered a faculty position in a prestigious department. McGinnis, Allison, and Long[24] showed that doctoral prestige is the most important determinant in obtaining a job after graduation. However, when one takes a postdoctoral position, the prestige of this new institutional affiliation replaces the prestige of the doctoral department. McGinnis, Allison, and Long[24] concluded that the choice of a postdoctoral position becomes critically important in determining one's future career chances.

Hargens and Hagstrom[30] found that productivity rates and prestige of doctoral institutions are of almost equal importance with regard to recruitment into the top ranks of graduate institutions. The prestige of doctoral institutions, however, has little effect in comparison with productivity, as far as avoidance of placement in the lowest prestige category.[30] Hargens and Hagstrom[30] also concluded that graduating from a highly prestigious doctoral institution may help one obtain a position in a highly prestigious institution but will not save one from placement in the bottom level of the system.

Hargens and Hagstrom[30] reported finding a strong relationship between the prestige of one's undergraduate institution and that of one's present academic affiliation. Moreover, departmental prestige has also been shown to affect the probability of having research studies published. It appears that publishing research can have consequences for an entire academic department. Gordon[31] analyzed 2572 refereed reports over a 6-year period from several prestigious physical science journals. His results revealed that reviewers evaluate papers from major universities significantly more favorably than papers from minor and less prestigious universities.

Crane[26] found that the prestige of a doctoral degree has more influence than productivity for obtaining a position in a leading

academic department. Crane[26] also found that, at later stages in the academic career, the effect of doctoral origin tends to diminish. Others, such as Hurlbert and Rosenfeld[25] and Youn and Zelterman,[32] have also found that the prestige of the doctorate-granting institution is less important for subsequent jobs and that the institutional prestige of the first job has the strongest effect on the last observed job.

Prestige has also been shown to affect productivity rate. Hargens and Hagstrom[30] discovered a surprisingly weak relationship between the prestige of a scientist's doctoral institution and his or her productivity rate. Other studies, however, have reported a significant relationship between these two variables.[6,15,33] Long[15] stated that productivity is most strongly affected by the prestige of the scientist's academic location, with scientists in prestigious departments exhibiting greater publication rates than those in less prestigious departments. Reasons for this discrepancy may include the possibilities that prestigious departments select more productive scientists for their faculty and provide more free time, superior resources, better research assistants, more stimulating colleagues, and stronger support for conducting research.[15,26,34]

Prestige also affects other aspects of education. Hargens and Hagstrom[30] reported that a strong relationship existed between ratings of academic prestige and average faculty salaries. Crane[35] suggested that, in addition to their higher salaries, scientists at high-prestige universities have a higher probability of receiving formal honorary rewards than those in lower-prestige universities. Merton[36] repeatedly observed that eminent scientists received disproportionately greater credit for their contributions, while relatively unknown scientists tended to receive disproportionately less credit for comparable contributions.

Merton[36] referred to this complex pattern of the misallocation of credit for scientific work as the "Matthew Effect." Merton[36] stated that universities with demonstrated scientific excellence are allocated greater resources for research and their prestige attracts a disproportionate share of promising graduate students. Merton[36] called this phenomenon the principle of cumulative advantages, and it has been supported by research across many different disciplines.[17,26]

Since ranking is a measure of prestige and since prestige is considered important as well as controversial in higher education, an examination of the issues that surround the establishment of rankings should be considered. Hartnett, Clark, and Baird[21] stated that the chief objection to using such rankings included unfair ratings to graduate programs that do not place primary emphasis on conducting research and preparing their students to do research. The university's reputation also unduly affects the program's reputation: the halo effect. The ratings are based on impressions of what a department used to be like, and the information gained from ratings seldom makes for a better understanding of a specific program's strengths and weaknesses.

ATHLETIC TRAINING EDUCATION PROGRAM RANKINGS

Since James McKeen Cattell published the first ranking of American institutions of higher education in 1910,[4] ranking systems have been justified by evaluators and researchers as a means of documenting accountability for university administrators. Because measures of accountability ultimately translate into national comparisons,[3] prestige hierarchies have formed within higher education, as evidenced by the periodic rank ordering in various measures of quality in institutions, departments, subfields of specialization, and scholarly journals. In fact, more than 40 states require assessment of academic programs in one form or another at the collegiate level.[2] Assessment is fueled not only by the demands of politicians but also, more importantly, by educators themselves.

In view of the significance of prestige hierarchies and retrenchment in higher education, it is not surprising that numerous large-scale studies assessing the quality and ranking of university programs across many academic fields have been conducted.[6–12,17,20,21,27,37,38] No studies, however, have specifically assessed the quality and ranking of athletic training programs. This is somewhat intriguing, considering that sports medicine has become an increasingly popular career choice in the last decade.[39] As sports medicine gains recognition within the medical community, the quality of education programs within athletic training becomes more critical than ever, and the demand for better-prepared professionals increases.[40]

This concern regarding the quality of education recently prompted the NATA's Educational Task Force to develop a set of preliminary recommendations designed to strengthen and improve athletic training education.[41] In a subsequent letter to NATA members, the leaders of the Task Force called for enhanced qualifications for athletic training educators, as well as a recommendation that, by 2004, all candidates for NATA certification must complete a Commission on Accreditation of Allied Health Education Programs-accredited athletic training education program. While much attention has been focused on undergraduate education by the Educational Task Force, graduate education is now more the rule than the exception. Therefore, as we move toward the 21st century, the demand for accountability will grow even more.

Despite the arguments against program ranking, a ranking process that could accurately describe, categorize, and rank the quality of undergraduate and graduate athletic training education programs would be valuable to many segments of society, not just to the academic components involved. For example, university administrators could use the results to guide their resource allocation and redistribution, as well as to recruit faculty. Faculty could use the results of program comparisons in recruiting outstanding graduate students, and potential students could use published descriptions and program rankings in the decision-making process as to which program to attend.[3] Moreover, accreditation agencies could use such results in their review process.[2] Ranking systems that delineate areas of research specialization may also help students to identify

programs that are productive in their interest area. Such ranking systems would be extremely helpful in assuring that students will obtain an education to meet their learning needs. Additionally, rankings such as this would also serve to alert outside agencies responsible for funding specific research projects related to sports medicine.

FUTURE DIRECTIONS

We have attempted to provide an understanding of academic ranking and a rationale for ranking athletic training education programs. Considering the need to help administrators, students, and faculty make informed decisions, program ranking of athletic training programs may be beneficial. Studies that document perceived quality are often used to rank programs. This resulting prestige ranking is often subjectively based. Productivity ranking, however, is generally regarded as a leading indicator of program quality.[42] Therefore, the frequency with which athletic training program personnel publish in the *Journal of Athletic Training* and other highly credible journals in related fields could be assessed and documented, along with the specific research area in which most of their productivity falls.

Productivity also comes in other forms. Presentations and service could also be indicators of productivity. For example, posters and free communications at the NATA Annual Meeting and Clinical Symposia could be tabulated, and athletic training programs could subsequently be ranked according to their frequency of presentation. The degree to which program faculty are involved in professional duties at the state, district, and national levels could also be factored in to gain a holistic picture of productivity.

There are, however, many additional issues aside from productivity that should be addressed. Considering the current flooded job market, we believe it is imperative to ask several questions regarding the ranking of athletic training education. (a) Do students who graduate from more prestigious schools find jobs more easily? (b) Do students who graduate from more prestigious schools get more prestigious jobs in the traditional setting? (c) Do students who graduate from more prestigious internship programs get better jobs than students who graduate from less prestigious internship programs? (d) Do students who graduate from an accredited program obtain better jobs than those who graduate from nonaccredited programs? (e) Do students who graduate from a more prestigious program get the better graduate assistant positions? (f) Do students with graduate assistantships at more prestigious schools obtain better jobs? (g) Does the reputation of the head athletic trainer promote the acquisition of a better job upon graduation? (h) What is the correlation between program rank and program budget? (i) To what extent are faculty salaries aligned with program rank? (j) How can quality teaching and service be included in program ranking studies?

Future research should be aimed at these questions and the aforementioned productivity rankings to enable administrators and faculty to make informed decisions about issues of resources, salary, and recruitment. Moreover, students can make educated decisions regarding which school they would like to attend for the best learning experience and the best employment opportunity upon graduation. We also, however, suggest one major caveat. While the ranking of athletic training educational programs may focus on productivity and perceived quality, many high-quality programs may go unnoticed due to a primary focus on teaching and service rather than research. Therefore, alternative models for program ranking must be developed to include quality teaching and service.

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The History and Evolution of Athletic Training Education in the United States

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Objective: To present a chronologic review of the history and evolution of athletic training education in the United States as related to the professional growth of athletic training and the National Athletic Trainers' Association.

Background: Commonly accepted characteristics of a profession are an identifiable body of knowledge, the emergence of practitioners as professional authorities, and community recognition. These characteristics establish the criteria by which the professional growth, or professionalization, of athletic training can be judged. With guidance from the National Athletic Trainers' Association, the development of athletic training education programs and credentialing of athletic trainers during the past 50 years have contributed to the professionalization of athletic training.

Description: We present a chronology of the contributions of the National Athletic Trainers' Association to the development of athletic training education in the United States. The activities of various committees, task forces, and Association members are reviewed and traced through the past 5 decades. Early curriculum models and the development of education programs in colleges and universities are discussed.

Advantages: The historical review of athletic training education in this article will enhance the reader's understanding of the relationships among education, credentialing of practitioners, and professionalism in athletic training.

Key Words: Committee on Gaining Recognition, Professional Education Committee, CAHEA, CAAHEP, JRC-AT, Education Task Force, Education Council

The evolution of athletic training education in the United States is closely intertwined with the history and development of the National Athletic Trainers' Association (NATA). As noted by O'Shea,[1] the NATA was founded with a stated purpose to "build and strengthen the profession of athletic training through the exchange of ideas, knowledge, and methods of athletic training." Beginning with this mission statement, athletic training education has continually benefited from the vision, wisdom, and nurturing of numerous NATA members. Shortly after the NATA was founded in 1950, several events that led to the development of athletic training education programs began to unfold. In 1955, William E. Newell, Purdue University, became the first athletic trainer to be appointed to the position of National Secretary of the NATA, a position that subsequently became known as Executive Director. One of Newell's first significant acts was to appoint a Committee on Gaining Recognition, which established a forum through which the seeds of athletic training education were planted.[2] As subsequent events revealed, this committee was the forerunner of the NATA Professional Education Committee, the committee that was to oversee athletic training education program development and approval for nearly 3 decades. From this modest beginning, athletic training education can be traced through 50 years of change, maturity, and emergence as a highly regarded avenue for the preparation of sports health care professionals. A chronologic overview of major events in the evolution of athletic training education is presented in Table 1.

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DEVELOPMENT OF A CURRICULUM MODEL: THE 1950s

Under William Newell's leadership as chair, the Committee on Gaining Recognition focused its attention on professional advancement. In 1956, the NATA Board of Directors authorized the committee to study avenues through which the professionalization of athletic training could be enhanced.[3] Athletic training education, along with national certification of athletic trainers, was chosen as a major vehicle.[2,3] One of the committee's initial endeavors was the development of a model curriculum for the professional preparation of athletic trainers. In 1959, after 3 years of work, the committee's recommenda-

Table 1. Major Events in the Evolution of Athletic Training Education

1955	NATA Committee on Gaining Recognition appointed
1959	First athletic training curriculum model approved by NATA
1969	NATA Professional Education Committee (PEC) and NATA Certification Committee developed (former subcommittees of Committee on Gaining Recognition)
	First undergraduate athletic training curriculums approved by NATA
1970	First national certification examination administered by NATA Certification Committee
1972	First graduate athletic training curriculum approved by the NATA
1980	NATA resolution requiring athletic training curriculum major, or equivalent, approved by NATA Board of Directors
1990	Athletic training recognized as an allied health profession by American Medical Association (AMA)
	Joint Review Committee on Educational Programs in Athletic Training (JRC-AT) formed
1991	*Essentials and Guidelines for an Accredited Educational Program for the Athletic Trainer*[17] approved by the AMA Council on Medical Education
1994	First entry-level athletic training educational programs accredited by AMA Committee on Allied Health Education and Accreditation (CAHEA)
	Commission on Accreditation of Allied Health Education Programs (CAAHEP) formed (replaced CAHEA as entry-level athletic training education program accreditation agency)
	NATA Education Task Force appointed
1996	NATA Education Task Force recommendations approved by NATA Board of Directors
	NATA Education Council formed

tions for an educational program were approved by the NATA Board of Directors.[1,3] Course requirements included in the 1959 athletic training curriculum model are summarized in Table 2.

A review of the first athletic training curriculum model adopted in 1959 reveals 2 important features that were directly related to the employability of athletic trainers in the late 1950s and the 1960s. The first major feature was an emphasis on attainment of a secondary-level teaching credential.[3] Largely because of a recognized need for employment of athletic trainers at the secondary school level, the curriculum was designed to prepare the student not only as an athletic trainer but also as a high school teacher, primarily in the areas of health or physical education. Aside from the specified courses in Table 2, athletic training students were required to complete prerequisites for a teaching credential as defined by their respective colleges and universities. A second major feature of the curriculum was the inclusion of courses that represented prerequisites for acceptance to schools of physical therapy, as suggested by the American Physical Therapy Association.[1,3] Perhaps due, in part, to the influence of William Newell, a physical therapist as well as an athletic trainer, athletic training students were encouraged to pursue further study in physical therapy as an additional means of professional growth and employability. Schwank and Miller[3] summarized the goals and objectives of the 1959 athletic training curriculum model as follows: "The program was designed to professionally prepare the prospective athletic trainer for a position at the secondary school level. An individual following this guided program could not only function as an athletic trainer, but could teach health, physical education, and adapted and specific programs for handicapped students. With additional study in a paramedical field, such as physical therapy as suggested by the NATA, the teacher-trainer can provide improved health care not only for student athletes but for the entire student body."

Based on the premise that development of a specialized, common body of knowledge is a prime characteristic of a profession, some observations can be made regarding the contributions of the athletic training curriculum model proposed by the NATA in 1959. Although development of the curriculum represented an important initial attempt to identify a specific body of knowledge for athletic trainers, a review of the curriculum reveals that it comprised primarily course work that already existed in 4-year colleges and universities, particularly in departments of physical education or health. With the exception of an advanced athletic training course and laboratory practice in athletic training, the proposed curriculum contained few courses that distinguished it from a typical major in physical education. Essentially, the curriculum represented a "packaging" of the most relevant courses available in related academic areas, rather than an attempt to add new educational experiences based on the identification of learning outcomes specific to athletic training. This early approach to education of athletic trainers is understandable, however, considering that the athletic training educator had not yet emerged on the academic scene. Because of the paucity of qualified instructors

Table 2. 1959 Athletic Training Curriculum Model

Physical therapy school prerequisites (minimum 24 semester hours)
Biology/zoology (8 semester hours)
Physics and/or chemistry (6 semester hours)
Social sciences (10 semester hours)
Electives (eg, hygiene, speech)
Specific course requirements (if not included above)
Anatomy
Physiology
Physiology of exercise
Applied anatomy and kinesiology
Laboratory physical science (6 semester hours, chemistry and/or physics)
Psychology (6 semester hours)
Coaching techniques (9 semester hours)
First aid and safety
Nutrition and foods
Remedial exercise
Organization and administration of health and physical education
Personal and community hygiene
Techniques of athletic training
Advanced techniques of athletic training
Laboratory practices (6 semester hours or equivalent)
Recommended courses
General physics
Pharmacology
Histology
Pathology

and specific athletic training course work, it is also understandable that continuation of the athletic training student's academic preparation through schools of physical therapy was encouraged.

EMERGENCE OF ATHLETIC TRAINING EDUCATION PROGRAMS: THE 1960s

The 10-year period after development of the original curriculum model in 1959 represented a significant void in the implementation of athletic training education programs. During the 1960s, only a few colleges and universities responded to the call for curriculum development. Nevertheless, the seeds of athletic training education began to sprout during the late 1960s. It was not until 1969, however, that the first undergraduate athletic training education programs were officially recognized by the NATA. In 1968, a survey of physical education department administrators in colleges and universities throughout the United States revealed that less than one half were aware of the proposed curriculum.[3] It became clear that implementation of athletic training education programs needed a renewed emphasis. In 1969, the Committee on Gaining Recognition, which by now had become known as the Professional Advancement Committee, was divided into 2 subcommittees, the Subcommittee on Professional Education and the Subcommittee on Certification.[2,4] Sayers "Bud" Miller, University of Washington, was appointed Chair of the Subcommittee on Professional Education, which subsequently evolved into the NATA Professional Education Committee. Despite slow progress, the Professional Education Committee evaluated and recommended NATA recognition of the first undergraduate athletic training education programs in 1969 (Mankato State University, Indiana State University, Lamar University, and the University of New Mexico). Thus, the NATA curriculum evaluation and approval process was born. During the late 1960s, graduate athletic training curriculums also began to emerge, although NATA approval of the first graduate athletic training education programs (Indiana State University and the University of Arizona) did not occur until 1972.

Paralleling emergence of the first undergraduate athletic training education programs in the late 1960s, a national certification examination was in the process of development by the NATA Certification Committee, formerly the Subcommittee on Certification.[2] Under the chairmanship of J. Lindsy McLean, Jr, University of Michigan, the NATA Certification Committee administered the first certification examination in 1970.[2,5] Subsequently, graduation from an NATA-approved athletic training education program (undergraduate or graduate) became one of 4 avenues through which eligibility for certification could be attained. During the ensuing years, completion of an apprenticeship program, graduation from a school of physical therapy, and a special consideration route (eg, minimum of 5 years as an "actively engaged" athletic trainer) were also established as avenues to certification. With the development of the first certification examination in 1970, athletic training education and national certification began to form parallel, complementary paths to future growth and development. In retrospect, the development of the first NATA-approved athletic training education programs and implementation of a certification examination were 2 historically significant events in the professionalization of athletic training, especially as related to community recognition and sanction. As a prime example, the American Medical Association, in a 1967 resolution,[2] publicly recognized the importance of the professionally prepared athletic trainer and commended the NATA for its efforts to upgrade professional standards. Similarly, during the next several years, public recognition of the NATA certification process came from various state medical associations, the Joint Commission on Competitive Safeguards and Medical Aspects of Sports, and the American Association for Health, Physical Education, and Recreation.[2,6]

PROLIFERATION OF NATA-APPROVED CURRICULUMS: THE 1970s

From a historical perspective, the 1970s represented the period of the greatest proliferation of athletic training education programs. In the 12-year period after the NATA recognized the first undergraduate athletic training education programs, the number of curriculums in colleges and universities throughout the country grew steadily, from 4 in 1969 to 62 by 1982.[7] As of June 1982, NATA-approved undergraduate programs existed in 33 states.[7] Meanwhile, 9 NATA-approved graduate athletic training education programs had been developed.[7] Although the original 1959 curriculum model continued as the basis for undergraduate curriculum approval during the early 1970s, the NATA Professional Education Committee continually reviewed and revised course work and clinical experience requirements. As relevant learning experiences evolved and the number of NATA-approved undergraduate programs increased, expanded opportunities for study specific to athletic training became available to an increasing number of students. Thus, there appeared to be less of a need for athletic training curriculums to include prerequisites for admission to physical therapy schools. Although attendance at physical therapy schools was still encouraged as a means of enhancing professional growth, the subject matter of athletic training began to assume a separate identity. By the mid 1970s, a revised athletic training curriculum had evolved (Table 3).[1,8] A comparison of this curriculum with the initial 1959 curriculum model indicates a transition from reliance on schools of physical therapy to a focus on courses considered, at the time, to be most specific to athletic training. Although still recommended as a basis for professional preparation in athletic training, extensive course work in subjects such as chemistry and physics, typically required by physical therapy programs, was no longer required as a condition of curriculum approval by the NATA.[8] These fundamental curriculum revisions were

Table 3. Mid 1970s Athletic Training Curriculum Course Requirements

Anatomy (1 course)
Physiology (1 course)
Physiology of exercise (1 course)
Applied anatomy and kinesiology (1 course)
Psychology (2 courses)
First aid and safety (1 course)
Nutrition (1 course)
Remedial exercise (1 course)
Personal, community, and school health (1 course)
Basic athletic training (1 course)
Advanced athletic training (1 course)
Laboratory or practical experience in athletic training to include a minimum of 600 total clock hours under the direct supervision of an NATA-certified athletic trainer

incorporated into the *Guidelines for Development and Implementation of NATA Approved Undergraduate Athletic Training Education Programs* (unreferenced, no longer available), one of the first comprehensive documents governing NATA approval of athletic training education programs. In a related endeavor during the 1970s, standards and guidelines governing NATA approval of graduate athletic training education programs were formalized and included in an analogous document, also referred to as the *Guidelines* (unreferenced, no longer available).

The original 1959 athletic training curriculum model (Table 2) required a course of study leading to a secondary-level teaching credential in physical education or health. Consequently, course work in pedagogy and coaching methods was specified. During the early 1970s, however, it became increasingly clear that high school teaching opportunities in physical education and health were limited. In reality, a teaching certificate in one of these 2 disciplines perhaps served to limit, rather than enhance, employment of certified athletic trainers at the high school level. The response to this realization was elimination of the requirement that athletic training students pursue a teaching credential in physical education or health. Nevertheless, the emphasis on obtaining a secondary teaching credential was retained throughout the 1970s. Although students in NATA-approved undergraduate programs were permitted to pursue the academic major of their choice, completion of requirements for a high school teaching certificate remained as a condition of program approval. This requirement was retained until 1980, after which completion of requirements for a secondary teaching credential was left to the discretion of the student. As a condition of NATA approval, however, colleges and universities sponsoring undergraduate athletic training education programs were still required to offer all courses leading to a secondary-level teaching credential.[8]

A critique of the curriculum model that evolved in the 1970s indicates limited but discernible progress toward identification of a specialized, common body of knowledge for certified athletic trainers. The elimination of course requirements that were considered to be more relevant to physical therapy or physical education than to athletic training serves as an example. Specifying a minimum number of clinical experience hours under the direct supervision of an NATA-certified athletic trainer further illustrates a move toward specialized learning experiences. Aside from the establishment of minimum clinical experience requirements, however, no subject matter areas were added to the original 1959 curriculum. Thus, revisions of the 1959 curriculum model that emerged during the 1970s represented an effort to eliminate irrelevant, or minimally relevant, content rather than an attempt to add new, innovative learning experiences. Despite the limited addition of curriculum offerings, the effect of these changes was to narrow the focus of athletic training education to a core of courses that could, at least theoretically, contribute the most to attainment of athletic training competencies.

In a related project during the 1970s, the NATA Professional Education Committee formalized a list of behavioral objectives that identified desired learning outcomes for the athletic training student.[6,8] This endeavor represented a significant early step toward identification of a specialized body of knowledge. Using the 11 required courses identified in Table 3 as a framework, the NATA Professional Education Committee developed a list of behavioral objectives for each course. In addition, a skill competency checklist was developed to guide and monitor development of the student's clinical skills.[8] Because the scope of the behavioral objectives was dictated and restricted by the existing content of required courses, the behavioral objectives did not represent a true competency-based approach to education of athletic training students. Nevertheless, with identification of relevant courses and development of corresponding learning objectives, the NATA Professional Education Committee began to identify a unique body of knowledge for the certified athletic trainer. In retrospect, the behavioral objectives developed during the 1970s provided a conceptual stimulus to formulation of the *Competencies in Athletic Training*,[9] subsequently developed by the Professional Education Committee in 1983.

DEVELOPMENT OF THE ATHLETIC TRAINING MAJOR: THE 1980s

During the late 1970s, it became apparent to the NATA Professional Education Committee that the increasing level of expertise expected of certified athletic trainers as health care professionals brought with it an obligation to provide educational programs with a broader and more relevant base.[2,7] The impracticality of providing the desired scope of educational experiences within the confines of academic specializations and concentrations was also recognized.[7] Before his untimely death in 1981, Sayers "Bud" Miller, chair of the Professional Education Committee, proposed the concept of an academic major in athletic training. His creative thinking and vision provided a powerful stimulus for major changes in athletic training education in the 1980s. As the number of NATA-approved undergraduate programs proliferated during the 1970s and as these programs expanded their course offerings,

the concept of an athletic training major became increasingly viewed as a reasonable and realistic educational goal. In June 1980, the NATA Board of Directors approved a resolution calling for all NATA-approved undergraduate athletic training education programs to offer a major field of study in athletic training by July 1, 1986.[7] As subsequent events demonstrated, this resolution provided a major catalyst for the most significant changes in athletic training education to date.

Following Sayers Miller's death, the Professional Education Committee was thrown into a temporary state of disarray, and progress toward development of a model for an athletic training major was disrupted. The concept of an athletic training major was kept alive, however, under the leadership of John Schrader, Indiana University, who succeeded Miller and served as interim chair of the Professional Education Committee until June 1982. Despite the absence of specific guidelines from the Professional Education Committee, at least 10 colleges and universities had either received institutional approval for program development or had implemented an athletic training major by 1982.[7] Several other schools were in the planning and developmental stages. Receptivity to the concept of an athletic training major among deans and department heads in colleges and universities with NATA-approved undergraduate programs was further substantiated by the results of a Professional Education Committee survey conducted during the 1981–1982 academic year.[7] Support from the 62 administrators surveyed was nearly unanimous. Only a handful indicated foreseeable barriers to implementation of an athletic training major in their respective schools.

With substantial support from college and university administrators as an incentive, the NATA Professional Education Committee began to develop strategic plans for approval of undergraduate education programs as academic majors. Under the direction of Gary Delforge, University of Arizona, who succeeded John Schrader as chair of the Professional Education Committee, further guidance was sought from the NATA Board of Directors. In February 1982, the Board of Directors approved a revised timetable for development and implementation of an athletic training major.[7] The original 1980 resolution, requiring that an athletic training major be fully implemented in all NATA-approved undergraduate programs by July 1, 1986, was revised to require that college and university officials be "in the process" of program development by this date. Subsequently, in June 1982, the Board of Directors approved a policy requiring withdrawal of NATA approval if college or university personnel failed to meet the July 1, 1986 deadline.[7] Correspondingly, procedures to demonstrate compliance were approved. To be considered in the process of developing an athletic training major, an institution sponsoring an NATA-approved undergraduate program was required to submit a letter from the administrator of the sponsoring department attesting to initiation of program planning and the intent to meet the implementation deadline. Additional required documents included a list of program goals and objectives, strategies for meeting the stated goals and objectives, and implementation progress reports.[7] As part of the revised timetable for implementation of an athletic training major, the NATA Board of Directors extended the original July 1, 1986 deadline to July 1, 1990.[7] This policy applied to all colleges and universities with undergraduate athletic training education programs initially approved by the NATA before July 1, 1986. In addition, the Board of Directors adopted the policy that, after July 1, 1986, initial NATA approval would be given only to programs that met the standards for an academic major.[7]

Following the establishment of a realistic timetable for implementation, the Professional Education Committee turned its attention to development of the components of an athletic training major. The Committee's efforts culminated in publication of the June 1983 edition of the *Guidelines for Development and Implementation of NATA Approved Undergraduate Athletic Training Education Programs,*[10] which contained the standards for development of undergraduate programs as academic majors. Publication of the 1983 *Guidelines* initiated the transformation of NATA-approved undergraduate athletic training education programs from specializations or concentrations to more comprehensive academic majors. A primary consideration that guided development of the 1983 *Guidelines* was the concept of an equivalent academic major. Realizing the difficulty in obtaining administrative approval of new academic programs in some colleges and universities, the Professional Education Committee developed the following definition of an equivalent athletic training major, which was approved by the NATA Board of Directors in February 1982: "A course of study in athletic training which is at least equivalent to the minimum number of semester/quarter hours which constitutes a major in the educational unit in which the athletic training education program is housed. The athletic training education program must also be designed so that students are provided with adequate opportunity to meet NATA specified behavioral objectives."[7]

As a guide to curriculum development, the Professional Education Committee offered a definition of an equivalent major as applied to a hypothetical situation. The committee's interpretation stipulated that, if a program of study in athletic training existed in a department of physical education that required a minimum of 45 semester units for completion of a major, the athletic training program must also include a minimum of 45 semester units. An equivalent major, as applied in this example, also necessitated inclusion of additional courses if the 45 semester units did not provide adequate opportunity for students to attain NATA-specified behavioral objectives.[7,10]

The policy allowing for NATA approval of an equivalent major precluded the need for an athletic training education program to receive institutional approval as a degree-granting program, thus facilitating implementation. Nevertheless, undergraduate programs receiving NATA approval as equivalent majors were held to the same standards as degree-granting programs with regard to the scope and relevancy of course offerings. The flexibility allowed by the equivalent major

facilitated identification of relevant course offerings in the sponsoring department or allied departments, addition of appropriate courses if necessary, and incorporation of these courses into an existing bachelor's degree program.[7,10,11]

In addition to the athletic training major, the 1983 *Guidelines*[10] incorporated 2 major features that represented conceptual changes in curriculum design. The first feature was inclusion of specified subject matter requirements, rather than specific courses (Table 4). In contrast with curriculum design based on specified courses, the subject matter approach permitted greater flexibility in the development of educational experiences, with varying degrees of emphasis on specific learning outcomes. The required subject matter could be developed as separate courses or incorporated as instructional units within existing courses, depending on determination of the appropriate emphasis. Developed during the 1981–1982 academic year, the *Competencies in Athletic Training*[9] represented a second major component of the 1983 *Guidelines*.[10] These *Competencies*,[9] which replaced the behavioral objectives developed during the 1970s, were based on the "performance domains" of a certified athletic trainer identified in the first role delineation study conducted by the NATA Board of Certification in 1982. Incorporation of the subject matter requirements and athletic training competencies into the 1983 *Guidelines*[10] represented an effort to promote the development of true competency-based athletic training education programs.

Following the resignation of Gary Delforge as chair of the NATA Professional Education Committee and appointment of Robert S. Behnke as the new chair in 1987, the Committee office moved from the University of Arizona to Indiana State University. During the late 1980s, the Professional Education Committee continued to oversee the conversion of NATA-approved undergraduate education programs to academic majors or equivalent majors until the process was complete in 1990. As of June 1, 1990, the deadline for implementation of an athletic training major, approximately one third of the 73 NATA-approved undergraduate athletic training education programs represented equivalent majors. The remainder were approved as formal majors offering a bachelor's degree in athletic training. In a somewhat unexpected development, NATA approval of programs with majors stimulated development of bachelor's degree programs. In several colleges and universities, programs initially approved as an equivalent major were subsequently submitted to governing bodies for institution approval as degree-granting programs.

Table 4. 1983 Athletic Training Curriculum Subject Matter Requirements

Prevention of athletic injuries/illnesses
Evaluation of athletic injuries/illnesses
First aid and emergency care
Therapeutic modalities
Therapeutic exercise
Administration of athletic training programs
Human anatomy
Human physiology
Exercise physiology
Kinesiology/biomechanics
Nutrition
Psychology
Personal/community health
Instructional methods

AMA RECOGNITION AND CAHEA ACCREDITATION: THE 1990s

During the late 1980s, preliminary work began that led to a milestone in the professional growth of athletic training and athletic training education. In June 1990, the American Medical Association (AMA) formally recognized athletic training as an allied health profession.[12] Several preliminary steps related to accreditation of entry-level athletic training education programs preceded AMA recognition. Efforts to obtain AMA recognition began with a decision by the NATA Board of Directors to seek accreditation of entry-level programs by the AMA Committee on Allied Health Education and Accreditation (CAHEA). As per AMA policy, formal recognition as an allied health profession was a necessary prerequisite for educational program accreditation by CAHEA. Thus, AMA recognition was sought for the primary purpose of programmatic accreditation through the CAHEA process.[12,13]

Investigation regarding accreditation of athletic training education programs by an outside agency actually began in the 1970s, largely through the efforts of Sayers Miller, the first chair of the NATA Professional Education Committee. Accreditation standards of 2 private-sector agencies, the Council on Postsecondary Accreditation and CAHEA, were reviewed.[12] Results of these investigations led to the conclusion that efforts to seek education program accreditation by an outside agency were premature. Consequently, a decision by the NATA Board of Directors to delay accreditation efforts pending further athletic training education program development resulted in suspension of further investigation. Nearly 10 years later, renewed interest in accreditation of athletic training education programs by an outside agency resulted from a review of previous investigative efforts. Under the leadership of Robert Behnke, investigations initiated in 1987 resulted in a recommendation to pursue accreditation of athletic training education programs by CAHEA. In June 1988, the NATA Board of Directors authorized the Professional Education Committee to seek accreditation through the CAHEA process.[14] The rationale for this decision was based on the perceived benefits of standardized education program requirements and external peer review by a highly regarded, specialized accreditation agency.[12,13] Public-sector recognition by the United States Department of Education of CAHEA as an accreditation agency for allied health professions was a corresponding consideration.

With the NATA Board of Director's approval, an extensive process was initiated to collect supporting documents and prepare an application for AMA recognition of athletic training as an allied health profession. After submission of the application, open public hearings were conducted during the 1989–1990 academic

year to allow input from interested health care communities. In early 1990, the AMA Council on Medical Education (CME) determined that athletic training met all criteria established by the AMA for recognition. On the recommendation of CME, the AMA House of Delegates officially recognized athletic training as an allied health profession on June 22, 1990.[12] Summarizing the response to this historic event, Robert Behnke commented: "It is extremely gratifying that the nation's largest medical organization has recognized athletic trainers. We really haven't had anyone formally acknowledge us as an allied health profession before. Athletic trainers now have a professional status in the health care field."

In October 1990, CAHEA staff members and NATA Professional Education Committee representatives met to form a review committee, one of the individual committees responsible for review of allied health education programs accredited by CAHEA. Various medical and allied health organizations involved in sports medicine were contacted to assess their interest as potential cosponsors. As a result, the American Academy of Family Physicians and the American Academy of Pediatrics joined the AMA and the NATA in appointing representatives to form a joint review committee, formally called the Joint Review Committee on Educational Programs in Athletic Training (JRC-AT). Subsequently, in January 1995, the American Orthopaedic Society for Sports Medicine joined the JRC-AT as a new cosponsor.[15] During the 8-year period after formation of the initial JRC-AT, Robert Behnke served in a dual capacity as the first chair of the JRC-AT and as chair of the NATA Professional Education Committee until the election of Peter Koehneke, Canisius College, as chair of the JRC-AT in January 1998, and until disbandment of the NATA Professional Education Committee in June 1998.

Once organized, the first task of the JRC-AT was the development of standards and guidelines to govern JRC-AT review and CAHEA accreditation of entry-level programs. This process was greatly facilitated by previous NATA Professional Education Committee efforts. With some modifications, the *Guidelines for Development and Implementation of NATA Approved Undergraduate Athletic Training Education Programs*[10] served as a basis for development of the new document, particularly as related to curriculum content and design. Basic concepts related to course subject matter requirements and the academic major in athletic training were incorporated. In addition, the *Competencies in Athletic Training*,[9] developed by the NATA Professional Education Committee in 1983, was retained as a "companion document." In cooperation with CAHEA staff members, the JRC-AT incorporated the major provisions of the NATA *Guidelines*[10] into a standardized CAHEA format.[16] Subsequently, *Essentials and Guidelines for an Accredited Educational Program for the Athletic Trainer*[16] was approved by the cooperating organizations and the AMA CME on December 6, 1991.[17]

With completion of the *Essentials*,[16] the mechanisms for JRC-AT program review were in place. In June 1993, the NATA Professional Education Committee discontinued its approval process for undergraduate athletic training education programs, and, in February 1994, the first 2 entry-level athletic training education programs (Barry University and High Point University) were accredited by CAHEA.[18] Accreditation of athletic training education programs by CAHEA was short-lived, however. In October 1992, the AMA proposed the establishment of a new, free-standing agency for accreditation of education programs in the allied health professions.[19] As proposed by the AMA, CAHEA was disbanded, and, in July 1994, the AMA became a cosponsor, rather than the primary sponsor, of the new independent agency, the Commission on Accreditation of Allied Health Education Programs (CAAHEP).[20] As was the case with CAHEA, the United States Department of Education recognized CAAHEP as an accreditation agency for educational programs in the allied health professions. Changes in federal regulations, however, led to voluntary discontinuation of United States Department of Education recognition in 1998.[21] Private-sector recognition of CAAHEP came from the Commission on Higher Education Accreditation (CHEA), a new organization formed by university presidents after disbandment of the Council on Postsecondary Accreditation in 1993.[20]

Although the CAHEA *Essentials*[16] became known as *Standards* and CAHEA review committees were referred to in the CAAHEP system as committees on accreditation, the CAAHEP accreditation procedures remained essentially the same as those used by CAHEA. Because of similarities in the review process, accreditation of entry-level athletic training educational programs continued without interruption during the transition from CAHEA to CAAHEP. During the 4-year period after CAHEA accreditation of the first 2 programs in 1994, athletic training education programs previously approved by the NATA were reviewed and accredited as new programs. As of June 1998, 82 entry-level programs had been accredited by CAAHEP, including 68 previously NATA-approved undergraduate programs. With scheduling of additional programs for review during the fall of 1998, the transition from the NATA education program approval to CAAHEP accreditation of entry-level educational programs was complete.

During the mid 1990s, 2 related policy changes by the NATA Board of Directors and the NATA Board of Certification (NATABOC) affected entry-level and graduate athletic training education. First, the NATA Professional Education Committee implemented the policy that, as of August 1996, NATA approval of graduate athletic training education programs would be granted only to those programs that offered "advanced" learning experiences beyond those required for CAAHEP accreditation of an entry-level program. Correspondingly, in June 1998, NATABOC discontinued "completion of an NATA-approved graduate program" as a route to certification. As a consequence, NATA approval of graduate-level programs required admission of students who had completed all requirements to sit for the certification examination or applicants who were NATABOC certified. Although CAAHEP policies permitted accreditation of entry-level programs at the graduate level, these NATA and NATABOC

policy changes established a clear distinction between entry-level program accreditation by CAAHEP and advanced graduate program approval by the NATA. With discontinuation of NATA-approved graduate athletic training education programs as a route to certification, further standardization of entry-level education requirements for certified athletic trainers was achieved. At the same time, however, advanced learning opportunities were encouraged through continued NATA recognition of graduate programs.

The delineation between entry-level and postcertification athletic training education in 1996 established new parameters for advanced learning and research at the graduate level. As indicated in the *Guidelines for Development and Implementation of NATA Approved Graduate Athletic Training Education Programs*,[22] research and scientific inquiry are considered distinguishing characteristics of graduate education. Despite this emphasis, Osternig[23] in 1988 noted that research in athletic training had "evolved much more slowly than practice and education." He referred to research as the "missing ingredient" in the pursuit of professionalism. In 1991, however, research was given a significant boost with establishment of the NATA Research and Education Foundation (NATA-REF), later referred to as the Foundation. As the result of an aggressive fund-raising campaign during the 1990s, the NATA-REF sponsored numerous research projects and awarded a significant number of academic scholarships. As evidenced by the number of publications in the *Journal of Athletic Training*, research productivity among certified athletic trainers increased dramatically during the 1990s. By the end of the decade, research was no longer viewed as a missing ingredient, and athletic training education had added a new dimension.

In 1997, a second major policy change by the NATABOC also represented a significant step toward standardization of education requirements for certified athletic trainers. In December 1996, the NATA Board of Directors adopted several recommendation submitted by the NATA Education Task Force, an ad hoc task force appointed in June 1994 to address the education and professional preparation of certified athletic trainers.[24–29] Among the 18 recommendations submitted to, and subsequently approved by, the Board of Directors was the recommendation that the NATA work with the NATABOC "to institute a requirement, to take effect in 2004, that, in order to be eligible for NATABOC certification, all candidates must possess a baccalaureate degree and have successfully completed a CAAHEP-accredited entry-level athletic training education program."[25–29] Pending implementation of this policy in 2004, the current internship route to NATABOC certification will be discontinued.[30] With elimination in the early 1980s of physical therapy programs and the special consideration route to certification, with discontinuation in 1998 of advanced graduate athletic training education programs, and with the impending elimination of the internship route, CAAHEP-accredited entry-level programs will become the only avenue to NATABOC certification. As noted by the NATA Education Task Force in 1996, this consolidation was proposed to standardize athletic training education and enhance consistency with professional preparation in other allied health disciplines.[26] With this explanation, the Task Force recognized the contributions of a standardized education system to the development of a specialized common body of knowledge among certified athletic trainers.

THE EDUCATION TASK FORCE AND EDUCATION COUNCIL: FOUNDATIONS FOR THE FUTURE

With formation of the Education Task Force in June 1994, the NATA extended the foundation for growth in athletic training education. The Education Task Force was charged with reviewing all aspects of athletic training education, including undergraduate (ie, curriculum and internship programs), graduate, and continuing education. Additionally, the NATA Board of Directors challenged the task force to present recommendations that would "influence the decisions the NATA Board of Directors must make concerning future direction of athletic trainer education and professional preparation."[26] Furthermore, the Board of Directors proclaimed that there should be "no limitations in this task force's scope of evaluations and/or recommendations."[26]

Presented with these challenges, the Education Task Force began an exhaustive 2-year study with John Schrader, Indiana University, and Richard Ray, Hope College, as cochairs. After identification of major issues and an analysis of future challenges in athletic training education, the task force formulated and presented 18 far-reaching recommendations, with supporting rationale, to the NATA Board of Directors in December 1996. All task force recommendations were adopted.[27] As directed, the task force addressed a wide range of education issues related to curriculum design, preparation of athletic training educators, program accreditation, and coordination of NATA education functions.

One of the Education Task Force recommendations was based on an identified need to "streamline the educational functions of the NATA."[26] Concerned about duplication of education services among various NATA committees and related groups, the task force recommended the creation of an Education Council to serve as the "clearinghouse for educational policy, development, and delivery."[28] In March 1996, the Education Council was formed to implement the Education Task Force recommendations, including continued dialogue with the Committee on Accreditation, the review committee for entry-level athletic training education in the CAAHEP accreditation system.[24,29–31] As proposed, approval of advanced graduate athletic education programs, now referred to as "accreditation," remained with the NATA. Accordingly, a revised document, *Standards and Guidelines for the Development and Implementation of NATA Accredited Graduate Athletic Training Education Programs*,[32] was developed in 1997. With development of the new *Standards*, NATA accreditation of graduate programs was implemented.

Following the creation of the Education Council, the NATA Professional Education Committee was officially disbanded in June 1998, after guiding the development of athletic training

education for the previous 28 years. Under the chairmanship of Chad Starkey, Northeastern University, the Executive Committee of the Education Council established 3 standing committees to address education issues at various levels: entry-level education, advanced graduate education, and continuing education.[33] With this structure and with the appointment of ad hoc committees to revise the *Competencies in Athletic Training*[9] and review clinical education, the Education Council was organized to provide continued leadership in the professional preparation of certified athletic trainers.

Whereas the NATA Education Council inherited many education issues in the domestic arena, developments during the late 1990s presented new challenges at the international level. In 1997, the NATA Board of Directors created the World Federation of Athletic Training Task Force to explore an international system for the education of athletic trainers.[34] On June 16, 1998, the Task Force hosted the first World Congress on Exploring Globalization of Health Care for the Physically Active in conjunction with the 49th NATA Annual Meeting and Clinical Symposia in Baltimore, Maryland. More than 50 sports medicine practitioners and educators from 10 countries were in attendance, including several NATABOC-certified international members of the NATA. With this beginning, the NATA positioned itself to provide leadership in athletic training education throughout the world, as it has in the United States for nearly 50 years.

CONCLUSIONS

A review of the major events in the history of athletic training education in the United States since the early 1950s reveals a sequence of events that, when viewed on a continuum, contributed significantly to the professional growth of athletic training. Each decade brought new leaders who not only had a vision for the future, but who also retained a sense of appreciation for previous accomplishments. In retrospect, this insight resulted in a noteworthy articulation of endeavors that have provided an identifiable body of knowledge, enhanced the professional identity of certified athletic trainers, and contributed significantly to the recognition of athletic training as a highly respected health care discipline.

ACKNOWLEDGMENTS

We thank Dr. John Schrader, Indiana University, for his review of our manuscript.

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Approval of Athletic Training Curriculums at Colleges and Universities

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On December 7, 1968, William E. Newell, chairman of the NATA Committee on Professional Advancement, appointed a subcommittee on curricular developments to determine the availability of academic opportunities in the area of athletic training. The objectives of this subcommittee's investigation were to determine the specific colleges and universities throughout the nation offering curriculums in athletic training, to ascertain whether those curriculums being offered in the area of athletic training fulfilled the basic minimal requirements (including specific course requirements) recommended by the NATA approved program of education, to develop a procedure for those institutions offering athletic training curriculums to submit their curriculums for NATA approval, and to recommend to the Board of Directors for their approval athletic training curriculums submitted by colleges and universities throughout the nation that meet the requirements of the NATA approved program of education. At this time I would like to bring you up to date on the accomplishments of this subcommittee in attempting to carry out these objectives.

Shortly after the formation of this subcommittee, which includes Whitey Gwynne, Ernie Biggs, Bobby Gunn, Tow Diehm, Bud Miller, medical advisors, and educational advisors, a questionnaire was developed to ascertain the colleges and universities offering, planning to offer, or interested in developing a curriculum in athletic training. Concurrently this questionnaire was designed to determine whether or not the institutions replying to this questionnaire offered a curriculum that fulfilled the requirements of the NATA approved program of education.

Upon the completion of this questionnaire, a list of institutions offering an undergraduate major in physical education or health education was obtained from the American Association of Health, Physical Education, and Recreation. Since it was felt that only institutions with an athletic trainer who is a member of the NATA would be qualified to offer the advanced course or courses in athletic training and to provide the proper supervision for the practical experience aspect of the NATA's educational program requirements, the questionnaire was mailed to only those institutions on the AAHPER list that have an athletic trainer, who is a member of the NATA, on its staff. Therefore, the questionnaire was sent to a total of 200 directors and heads of college physical education departments from the AAHPER list that met the aforementioned criteria. Out of these 200 questionnaires, 155 (77.5%) were returned; however, one institution reported in its returned questionnaire that they had dropped their physical education major and this response was not included in the study.

Although a considerable amount of data were collected from this survey questionnaire, only the pertinent findings to the progress of the curricular development subcommittee in its work will be reported at this time in this article. It is hoped that the entire study and its findings can be presented in a future issue of the *Journal*.

SIGNIFICANT FINDING

A very significant finding from this questionnaire was that the directors and heads of physical education departments are poorly informed about the NATA's educational program. It was discovered that less than one-half (46.2%) of the heads of physical education departments had any knowledge of the educational program approved by the NATA in 1959. Consequently, the recommendation of the subcommittee to the NATA Board of Directors at the 1969 national meeting was that an informational brochure explaining the role of the athletic trainer and providing the guidelines for the development of curriculums that will professionally prepare the athletic trainer should be developed and then published. With the completion of this type of publication, the NATA could use it for two purposes—information and recruitment. This type of brochure could be sent to all physical education department heads to assist in their education of our efforts in the area of professional preparation and to seek their assistance and support in the establishment of athletic training curriculums that meet the standards established by the NATA. This recommendation was approved by the Board of Directors and the subcommittee is working on this project at the present time.

From the same questionnaire, nineteen institutions indicated that they offered a specific curriculum in athletic training. In

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addition, another twenty-three institutions also indicated future plans in developing athletic training curriculums. These curriculums took various forms including a major field of study, a minor, an option within an established major, and a less formal area of specialization. Further examination of these curriculums, however, indicates that only five of the aforementioned institutions meet all of the specific course requirements of the NATA educational program. Although only five institutions from this survey could fulfill all the requirements of the NATA educational program, the subcommittee felt that the 42 institutions indicating that they offer or plan to offer a curriculum in athletic training in this survey provided a good potential core if a few revisions were made in these curriculums. Therefore, the subcommittee decided to invite the 42 institutions to submit their curriculums for NATA approval according to the following procedure which had been developed earlier by the subcommittee.

PROCEDURE

1. Submission of a letter from the head of the department, division or college in which the athletic training curriculum is offered stating that the curriculum has been approved by university officials as an official field of study.
2. Submission of a copy of the athletic training curriculum offered by the institution and a copy or copies of the appropriate university catalog or academic bulletin listing the offering of the athletic training curriculum. If this curriculum is a recently developed one, it is very likely that it will not be published for one or two years later. Therefore, this requirement can be waived in this case and the bulletin or catalog sent at a later date when it is published.
3. Submission of a completed questionnaire which can be obtained from the following address: Sayers J. Miller, Athletic Trainer, Tubby Graves Building, University of Washington, Seattle, Washington 98105.

All of the aforementioned documents should also be sent to this same address upon completion. From these 42 letters, the subcommittee immediately received four applications for curriculum approval. Since all four of these athletic training curriculums fulfilled all of the requirements of the NATA educational program, the Board of Directors made its first official action in the approving of athletic training curriculums. Indiana State University, Lamar Tech, Mankato State College and New Mexico University were the first institutions to receive from the NATA an official letter recognizing their curriculum's approval.

However, since the approval of these four curriculums, only two more curriculums have been received by the subcommittee. At the present time these curriculums are being studied by the subcommittee. Another six institutions have also written indicating that they are in the process of having their curriculums developed or are being approved by their institutions. The quantity of responses would seem to be discouraging; however, it must be remembered that the development of curriculums and university official approval procedures are very slow. A good example is the paramedical field of physical therapy which has been established in the area of professional preparation for a much greater period of time than the NATA and still has today less than fifty institutions officially approved to professionally prepare its members. Therefore, if you have an athletic training curriculum or are planning one, it is the plea of this subcommittee to get the ball rolling now toward its approval by your own institution and the NATA.

Finally, it was discovered from the survey questionnaires sent out by the subcommittee that a good number of the heads of physical education departments did not understand the need for an advanced course in athletic training beyond the basic course in athletic training offered by most colleges and universities. Therefore, the subcommittee is also attempting at the present time to set down in a written statement the rationale for an advanced course or courses in athletic training. This statement upon its completion will be submitted to the Board of Directors for this body's official approval.

The membership's assistance in the projects being carried out by this subcommittee has been greatly appreciated. We only ask that you continue to submit advice, assistance and questions concerning these projects.

Abstracts

Clint Thompson, MS, ATC

Turnbull JR. Acromioclavicular joint disorders. *Med Sci Sports Exerc*. 1998; 30(suppl):S26-S32.

The acromioclavicular joint is commonly involved in athletic injuries. Most commonly, a sprain to the joint occurs with variability in the amount of ligamentous damage and displacement that occurs. In all but the most severe dislocations, treatment consists of initial sling immobilization and early functional rehabilitation. The outcome is usually excellent with full return of function following these injuries. The rarer types (IV, V, and VI) require operative reduction and fixation. Distal clavicle fractures are related injuries, which many times disrupt the stabilizing ligaments of the acromioclavicular joint. Many can be treated nonoperatively, but there are several subtypes that should be considered for early fixation to reduce complications of pain and shoulder dysfunction. An atraumatic, overuse condition, which is becoming more prevalent and seems related to weight training, is osteolysis of the distal clavicle. There is insidious onset of shoulder pain with symptoms and signs consistent with acromioclavicular pathology. Activity modification is the best method of controlling symptoms. Failure of the conservative approach necessitates operative excision of the distal clavicle.

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Gleeson NP, Reilly T, Mercer TH, Rakowski S, Rees D. Influence of acute endurance activity on leg neuromuscular and musculoskeletal performance. *Med Sci Sports Exerc*. 1998;30: 596–608.

PURPOSE: The purpose of this study was to investigate the effect of endurance activities designed to simulate the physiological demands of soccer match-play and training, on leg strength, electromechanical delay, and knee laxity. METHODS: Eight recreational soccer players completed 4 exercise trials in random order: 1) a prolonged intermittent high intensity shuttle run (PHISR), which required subjects to complete a total distance of 9600 m in a form simulating the pattern of physical activity in soccer match-play (activity mode; rest-to-work intervals; approximately 90 min duration); 2) a shuttle-run (SR); 3) a treadmill run (TR), which required subjects to complete an equivalent distance at a running speed corresponding to 70% Vo_{2max}; and 4) a control condition consisting of no exercise. RESULTS: Results from repeated measures ANOVA revealed significant condition (PHISR; SR; TR; control) by time (pre; mid; post) interactions for peak torque (PT: knee extension and flexion, 1.05 $rad \cdot s^{-1}$), EMD and anterior tibio-femoral displacement (TFD) ($P < .05$). Impairment to indices of knee joint performance was observed in PHISR, SR, and TR trials. The greatest decrement occurred in PHISR and SR trials (up to 44%). Knee extensor and flexor strength performance near to full knee extension (0.44 rad knee flexion) was not changed following the functionally relevant endurance activities. CONCLUSIONS: Even though strength performance near to full knee extension was preserved following acute endurance activities, the risk of ligamentous injury may be increased by concomitant impairment to EMD and anterior TFD.

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Wilmore JH, Morton AR, Gilbey HJ, Wood RJ. Role of taste preference on fluid intake during and after 90 min of running at 60% of Vo_{2max} in the heat. *Med Sci Sports Exerc*. 1998;30:587–595.

PURPOSE: The purpose of this study was to determine the relationship between taste preference and total fluid intake during a 90-min run at 60% VO_{2max} as well as during a 90-min period of seated recovery under hyperthermic conditions (30°C, 50% RH), comparing the *ad libitum* intake of water and two carbohydrate-electrolyte drinks (one containing 6% CHO and the other 8% CHO) randomized over three trails. METHODS: Fifteen men runners and triathletes, 18 to 40 yr of age, completed an initial test to determine Vo_{2max}, a practice 90-min run at 60% Vo_{2max}, and three experimental 90-min run/90-min recovery trials on separate days approximately 1 wk apart. RESULTS: There were no differences across the three treatments in fluid intake, rectal temperature, or RPE during exercise, but subjects consumed 54% and 59% more fluid during recovery with the two carbohydrate-electrolyte drinks compared with water. When comparing the subjects' trials with the most liked versus the least liked of the three fluids, they consumed more of the most liked fluid during exercise (1.10 vs 0.97 $L \cdot 90\ min^{-1}$) but not during recovery (1.02 vs 0.90 $L \cdot 90\ min^{-1}$ [NS]). CONCLUSIONS: Thus, perceived taste of a beverage is important for fluid replacement during exercise.

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Livingston LA. The quadriceps angle: a review of the literature. *J Orthop Sports Phys Ther*. 1998;28:105–109.

Previous investigations of the quadriceps (Q) angle and its relationship to knee disorders have yielded equivocal results. The purpose of this paper is to present a review of the current literature on the Q angle and to examine the differences in Q angles when measured: 1) under differing measurement protocols; 2) between asymptomatic and symptomatic populations; 3) between male and female samples; and 4) from

side to side within subjects. Little scientific evidence exists to support the commonly held assumptions that Q angles are larger in symptomatic versus asymptomatic or that they are equal in the right versus left lower limb. However, larger mean values are consistently observed in groups of young adult females versus young adult males.

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Walsworth M, Schneider R, Schultz J, et al. Prediction of 10 repetition maximum for short-arc quadriceps exercise, from hand-held dynamometer and anthropometric measurements. *J Orthop Sports Phys Ther.* 1998;28: 97–104.

Short-arc quadriceps exercise are commonly prescribed in physical therapy for strengthening knee extensor musculature. Determining the appropriate starting resistance has traditionally been a trial-and-error procedure. Therefore, developing an expedient method of estimating the correct starting resistance may lead to a more accurate exercise prescription. The primary purpose of this study was to establish a technique for predicting an individual's 10 repetition maximum (10 RM) based on hand-held dynamometer (HHD) strength recording and additional anthropometric predictor variables. Fifty healthy subjects (31 males and 19 females), aged 22–53 years, participated in the study. A prediction equation for determining 10 RM using HHD strength recording, weight, gender, and age was developed. By implementing this equation, clinicians can predict a normal, healthy, young to middle-aged adult's 10 RM within ± 4.17 kg with a 95% confidence level (SEE = 2.13 kg).

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Fritz JM, Delitto A, Erhard RE, Roman M. An examination of the selective tissue tension scheme, with evidence for the concept of a capsular pattern of the knee. *Phys Ther.* 1998; 78:1046–1056; discussion 1057–1061.

BACKGROUND AND PURPOSE: The purpose of this study was to examine whether there is evidence to support 2 elements of the passive-range-of-motion (PROM) portion of Cyriax's selective tissue tension scheme for patients with knee dysfunction: a capsular pattern of motion restriction and the pain-resistance sequence. SUBJECTS: One hundred fifty-two subjects with unilateral knee dysfunction participated. The subjects had a mean age of 40.0 years (SD = 15.9, range = 13–82). METHODS: Passive range of motion of the knee and the relationship between the onset of pain and resistance to PROM (pain-resistance sequence) were measured, and 4 tests for inflammation were used. Interrater reliability was assessed on 35 subjects. RESULTS: Kappa values for the individual inflammatory tests ranged from 0.21 to 0.66 for categorization of the joint as inflamed, based on at least 2 positive inflammatory tests (kappa = 0.76). Reliability of PROM measurements was indicated by intraclass correlation coefficients of 0.72 to 0.97. Reliability of measurements of the pain-resistance sequence was indicated by a weighted kappa of 0.28. A capsular pattern, defined as a ratio of loss of extension to loss of flexion during PROM of between 0.03 and 0.50, was more likely than a noncapsular pattern in patients with an inflamed knee or osteoarthrosis (likelihood ratio = 3.2). An association was found between a capsular pattern and arthrosis or arthritis. CONCLUSION AND DISCUSSION: These findings provide evidence to support the concept of a capsular pattern of motion restriction in persons with inflamed knees or evidence of osteoarthrosis.

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Van Dillen LR, Sahrmann SA, Norton BJ, et al. Reliability of physical examination items used for classification of patients with low back pain. *Phys Ther.* 1998;78:979–988.

BACKGROUND AND PURPOSE: The purpose of this study was to examine the interrater reliability of measurements obtained by examiners administering tests proposed to be important for classifying low back pain (LBP) problems. SUBJECTS: Ninety-five subjects with LBP (41 men, 54 women) and 43 subjects without LBP (17 men, 26 women) were examined by 5 therapists trained in the techniques used. METHODS: A manual was developed by the first author that described the clinical examination procedures. The therapists were trained by the first author in the test procedures and definitions. The training included instruction through videotapes, practice and a written examination. Each examination was conducted by a pair of therapists. Within a pair, a therapist was the primary examiner for half of the subjects and an observer was the primary examiner for half of the subjects. Examination findings were recorded independently, without discussion. RESULTS: Percentage of agreement and generalized kappa coefficients were used to analyzed the data. Kappa values were ≥ .75 for all 28 items related to the symptoms elicited and ≥ .40 for 72% of the 25 items related to alignment and movement. CONCLUSION AND DISCUSSION: The results suggest that experienced therapists who had trained together were able to agree on the results of examinations and obtain an acceptable level of reliability. Future work should focus on testing of reliability when more than one therapist performs the examination and when therapist not trained by the test developer to administer the examination performs the tests.

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Dye SF, Vaupel GL, Dye CC. Conscious neurosensory mapping of the internal structures of the human knee without intraarticular anesthesia. *Am J Sports Med.* 1998;26:773–777.

The conscious neurosensory characteristics of the internal components of the human knee were documented by instrumented arthroscopic palpation without intraarticular anesthesia. With

only local anesthesia injected at the portal sites, the first author (SFD) had both knees inspected arthroscopically. Subjectively, he graded the sensation from no sensation (0) to severe pain (4), with a modifier of either accurate spatial localization (A) or poor spatial localization (B). The nature of the intraarticular sensation was variable, ranging from 0 on the patellar articular cartilage to 4A on the anterior synovium, fat pad and joint capsule. The sensation arising from the cruciate ligaments ranged from 1 to 2B in the midportion, and from 3 to 4B at the insertion sites. The sensation of the meniscal cartilages ranged from 1B on the inner rim to 3B near the capsular margin. Innervation of most intraarticular components of the knee is probably crucial for tissue homeostasis. Failure of current intraarticular soft tissue reconstructions of the knee may be due, in part, to the lack of neurosensory restoration. Research studies of the knee designed to delineate factors that restore neurosensory characteristics of the musculoskeletal system may lead to techniques that result in true restoration of the joint homeostasis and function.

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Maddali S, Rodeo SA, Barnes R, Warren RF, Murrell GAC. Postexercise increase in nitric oxide in football players with muscle cramps. *Am J Sports Med.* 1998;26:820–824.

Nitric oxide, a free radical inter- and intracellular messenger molecule, is important in exercise physiology. This study tested the hypothesis that serum nitric oxide concentrations change after strenuous exercise with severe generalized muscle cramps. The study group consisted of 77 professional football players in preseason training. All players' concentrations of serum nitrite and of other serum chemicals were determined during their preseason evaluations and compared with the concentrations in 40 serum samples taken from 25 of those same players who required intravenous rehydration for severe generalized muscle cramps after a training session. Player weight and percentage of body fat were significantly higher in players who received intravenous fluids than in players who did not. The serum of players requiring intravenous hydration showed evidence of skeletal muscle breakdown (increases in lactate dehydrogenase, creatinine phosphokinase, aspartate aminotransferase, and alanine aminotransferase) and of dehydration (elevations in protein, blood urea nitrogen, and cholesterol). The major finding, however, was a nearly 300% increase in serum nitrite concentrations in players requiring rehydration. There were no correlations between concentrations of nitrate and of any of the other serum chemicals. These data support the hypothesis that large amounts of nitric oxide are synthesized in professional football players after strenuous exercise with severe muscle cramps. The study design did not allow us to determine whether this increase in nitric oxide was due to exercise or muscle cramps or both, but it does provide a basis for evaluating these relationships.

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Greenwald RM, Janes PC, Swanson SC, McDonald TR. Dynamic impact response of human cadaveric forearms using a wrist brace. *Am J Sports Med.* 1998;26:725–730.

The purpose of this study was to compare the dynamic impact response of braced and unbraced cadaveric wrists using a commercially available wrist guard. Twelve arms were harvested from six cadavers. Each pair of forearms, one with and one without a brace, were impacted using a modified guillotine-type drop fixture placed over a force platform. Using a piece-wise linear regression analysis, we identified four phases of dynamic loading in the vertical force profile before fracture. These phases included an initial linear loading phase starting at impact, followed by a nonlinear phase, a second rapid linear loading phase, and a final nonlinear loading phase to failure. Three transition points were identified that defined the boundaries of the linear loading phases. Vertical force and impulse were significantly higher ($P < .01$) at each transition point and at failure in all braced specimens compared with unbraced specimens. However, the most noticeable differences were found during the initial two loading phases. Time to each transition point and to failure was not significantly different ($P >. 27$) between the braced and unbraced wrists. The results of this study differ from those obtained under more quasistatic loading conditions. Dynamic impact testing suggests that wrist guards may have a prophylactic effect during low-energy dynamic impact situations.

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Vergis A, Gillquist J. Sagittal plane translation of the knee during stair walking: comparison of healthy and anterior cruciate ligament-deficient subjects. *Am J Sports Med.* 1998;26:841–846.

With an electrogoniometer system, we made bilateral measurements of the maximal sagittal plane anterior-posterior knee translations in 15 healthy subjects (controls) and 14 patients with arthroscopically confirmed unilateral anterior cruciate ligament deficiency during two types of ascents and descents (straight and side). In both groups, during the ascent cycle the tibia moved anteriorly in relation to the femur, whereas during the descent cycle it moved posteriorly. There was wide individual variation in maximal translation in both the control and anterior cruciate ligament-deficient groups (range, 1 to 12 mm; median, 7 mm). The maximal translations were similar in both groups ($P > .05$), but they occurred at significantly smaller flexion angle in the injured knees (38° ± 8°) than in the control and non-injured knees (44°± 8°) ($P < .05$). The translation during step ascent and descent did not differ between the injured and control knees. These findings indicated that patients with anterior cruciate ligament injuries are able to control abnormal anterior translation during normal activity.

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The Quick Reference Guide to Sports Injury Management is described by the authors as a field manual that is intended to serve as a quick, easy-to-access guide for the athletic trainer. Although the guide serves as a comprehensive source of information, its primary purpose is to succinctly list relevant information in such a way that the reader doesn't have to skim through a lot of superfluous information. This format quickly provides etiology, signs, symptoms, and strategies for managing an injury. In this guide, the authors do not give detailed explanations found in a reference textbook, since they assume that certified athletic trainers already possess the requisite knowledge and skills.

This text provides basically the same information as Anderson and Hall's other textbooks, *Sports Injury Management* and *Fundamentals of Sports Injury Management*. An interactive relationship with these other textbooks gives the reader access to additional resources, providing a depth of information that the *Quick Reference Guide* is not designed to give.

Although this material would not be suitable as a primary textbook for the athletic training classroom, it would be suitable as a supplemental source to complement the knowledge base of an upper-level student athletic trainer or an entry-level certified athletic trainer. This source would also be relevant for other health care professionals who serve the medical needs of athletes.

This textbook is similar in design to other sports medicine references with a reference guide format. Anderson and Martin's textbook and *The Rehabilitation Specialist Handbook,* 2nd edition, by Rothstein, Roy, and Wolf, are also comprehensive reference guides intended to provide prompt information when it is needed. I found that these types of textbooks usually provide precise information, although each guide has a specific focus. By using this guide, the reader can readily investigate a problem and obtain a quick answer.

Uniquely, this book has no pictures or illustrations and very few tables. This provides the reader with an opportunity to peruse the text without having to refer to illustrations or tables. Pictures and illustrations are typically useful tools in textbooks, but, in this case, the absence of such distractions benefits the flow of the text. This guide is very user friendly and easy to read. The special icons that highlight the management section of each topic allow the reader to easily identify each section.

Since the authors chose not to include a reference list at the end of each chapter, I suggest that future editions of this textbook make better use of the suggested reference list in appendix 3. The authors could categorize these sources into sections similar to a table of contents, so the list can be used more effectively. Appendix 3, as presented, does not assist the reader but simply presents a list of sources. I believe that the textbook would be strengthened if it provided a cross-referencing between the subject and the appendix.

At $29.95, this textbook is fairly priced and affordable. Its target readers are athletic trainers, but it would also be

suitable for students in athletic training and for a variety of health care professionals whose primary responsibilities are in managing the needs of competitive athletes.

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Rehabilitation in Sports Medicine: A Comprehensive Guide
Paul Canavan
Appleton & Lange, Stamford, CT
1998
399 pages
ISBN 0-8385-8313-X
Price: $60.00

This book is designed to be a reference guide for the surgical and nonsurgical rehabilitation of common orthopaedic injuries, incorporating strength and conditioning, injury prevention, nutrition and sports, psychology, and physiologic factors. There are chapters on strength and conditioning planning; nutrition and sports; the role of the primary care physician, coach, and athlete in rehabilitation; the physiologic basis for strength training in injury prevention and rehabilitation of injuries; and psychological considerations in working with injured athletes. Other chapters, which were written by professionals with expertise in a particular content area, detail rehabilitation for those specific anatomical regions of the body. These chapters, which include sections on anatomy and biomechanics, cover the rehabilitation of specific body regions: cervical, thoracic, and lumbar spine; shoulder; hip and pelvis; knee; and foot and ankle. This arrangement provides a consistent structure throughout the book. The chapters are generally well written, featuring up-to-date information. All the rehabilitation chapters include useful pictures and diagrams, making the rehabilitation procedures understandable and readily applicable to practice.

Each chapter contains information that is very pertinent to athletic training. The book presents information not only on aspects of injury rehabilitation, but also on several other domains within the profession of athletic training, including nutrition, injury prevention, and psychological considerations. The information given on rehabilitation of specific body regions is current and applicable. By including a broader range of topics, this book has an advantage over rehabilitation texts that focus strictly on treatment techniques.

Because many of the chapters on rehabilitation of specific body regions contain only cursory coverage of the anatomy and biomechanics and focus primarily on rehabilitation, the text is somewhat less appropriate for introductory athletic training courses that require more detailed descriptions of anatomy and biomechanics. It would be more useful for advanced courses or for courses focused specifically on rehabilitation. The book costs $60.00, which is comparable with other textbooks on injury rehabilitation and seems justifiable, given the depth of information offered by this text.

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Jumping Into Plyometrics
Donald A. Chu, PhD
Human Kinetics, Champaign, IL
1998
2nd edition
176 pages
ISBN: 0-88011-846-6
Price: $15.95

Professionals associated with the rehabilitation, strengthening, or conditioning of athletes should find *Jumping into Plyometrics* beneficial to their practices. This is the most comprehensive reference on plyometric exercises I have read since Dr. Chu's first edition of this book. In this edition, Dr. Chu offers creative ideas and innovative exercises for the latter stages of rehabilitation and functional conditioning. This text furnishes educators and advanced students in athletic training with pertinent information on plyometric training and provides a theoretical basis for the use of plyometrics, while also offering examples of functional rehabilitative exercises. It could be a resource for athletic training courses that discuss basic concepts of rehabilitation (as in therapeutic exercise) as well as courses relevant to the strength and conditioning of athletes.

However, students should have a basic knowledge of exercise physiology and rehabilitation in order to comprehend and properly apply this information. The terminology used in the first 2 chapters could be confusing if the student is deficient in these areas. Chapters 3 through 5 are very well written. I was particularly impressed with the thorough description of each exercise and the emphasis on progression and safety. Dr. Chu's illustrations are excellent and complement his descriptions, making the information easy to understand.

This text is also an excellent clinical reference for certified athletic trainers and physical therapists. Dr. Chu's explanation of each exercise and the organization of these exercises into programs provide the reader with examples of how to integrate plyometrics into rehabilitation. *Jumping into Plyometrics* would be an invaluable supplement for professionals who focus specifically on strength and conditioning in athletic populations. The unique concepts and training methods would undoubtedly enhance traditional strengthening programs. His detailed descriptions of the exercises and the sequential progression into safe and effective programs could offer coaches effective and inexpensive alternatives for strength and conditioning programs.

Jumping into Plyometrics offers contemporary concepts for the integration of plyometrics into rehabilitation, strength, and conditioning programs. While plyometric exercises have been implemented in these forums, few understand the basic science and recovery period necessary to make plyometrics safe, efficient, and effective. This text addresses these issues while also discussing when and how to use plyometric exercises. In addition, Dr. Chu has used these programs in his own practice, giving merit to this information and to his level of expertise in strength and conditioning. Although I consider this text to be a supplement when used by educators for teaching the intricacies of rehabilitation and conditioning programs, it is the most comprehensive source of information specifically about plyometric training. The cost of the book is very reasonable for the volume of information provided.

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Introduction to Surface Electromyography

Jeffrey R. Cram, PhD, and Glenn S. Kasman, MS, PT, with Jonathan Holtz, MA, PT

Aspen Publications, Gaithersburg, MD

1998

408 pages

ISBN: 0-8342-0751-6

Price: $55.00

The purpose of this text is to provide the reader with the necessary knowledge of anatomy, physiologic basis for electromyography, principles of neuromotor control, and instrumentation to effectively use surface electromyography (sEMG) in an applied setting. This text also has a companion text, *Clinical Applications in Surface Electromyography: Chronic Musculoskeletal Pain*, which deals more extensively with a variety of applications of sEMG.

The authors begin the text with a discussion of the benefits and limitations of sEMG. sEMG allows the clinician to obtain information regarding the firing and recruitment patterns of a muscle group and the degree of motor control the patient is able to exert over movement. While sEMG is useful as a muscle re-education tool, the authors are quick to note its limitations, which involve the complexity of the neuromuscular system and the state of today's instrumentation.

Neuromuscular anatomy and physiology (including a review of the physiology of muscle contraction, properties of motor units, and sensory-motor integration) are presented in chapter 2. These complex topics are presented in a relatively clear, easy-to-understand language, with excellent illustrations. The discussion of primitive motor reflexes and their integration into skilled movement is useful information for those wishing to increase their understanding of the complexities surrounding human movement. Near the end of the chapter, I would like to see greater discussion of rate coding and recruitment in the context of factors that govern force development.

Chapter 3 is devoted to a discussion of instrumentation, to familiarize the reader with how the sEMG signal is generated and processed. The most valuable component of this chapter is the checklist for equipment specifications, including desirable ranges and comments about each feature that assist the clinician in making a wise purchase decision. Electrodes and their placement, as critical components in signal detection, are discussed in chapter 4.

Since the appropriate physical treatment follows an accurate functional working diagnosis, an accurate physical assessment and the implications of the results are discussed in chapter 5. Understanding the effects of tissue types (adipose and skin, for example), posture, position, and dynamic movement on the sEMG signal will facilitate an accurate interpretation of the clinical observations. There is a brief discussion of clinical syndromes, including postural dysfunction, learned muscle guarding, weakness or deconditioning, acute reflex inhibition, compensation for joint hypermobility or hypomobility, and chronic faulty motor programs—all concerns for the clinician dealing with musculoskeletal problems. Evaluation and treatment algorithms are a useful visual aid for clinical decision making. Chapters 6, 7, and 8 present specific clinical evaluation protocols, including electrode placements and keys to accurate interpretation of the results.

Chapter 9 presents treatment considerations and protocols to use following the clinical assessment. The primary topics for treatment include dynamic relaxation and neuromuscular re-education. The concluding chapters in part I focus on documentation and commentary on the future role of sEMG. The authors stress the importance of the judicious use of sEMG as a tool to enhance existing evaluation and treatment skills. The chapters on assessment and treatment clearly reflect the authors' clinical experience with sEMG.

Part II contains a complete atlas for electrode placement for each muscle group. Anyone who has searched for a definitive atlas for electrode placement need look no further; this reference contains more complete information than any other resource I've seen in the marketplace. Each section contains the clinical uses, electrode placement location (including an illustration for each site), behavioral tests used to elicit specific activity, tracing comments based on sample recordings provided, clinical considerations for placement, and benchmark values (including technical information). This section of the book is the most valuable for any health care provider using sEMG as an assessment and treatment tool.

Overall, this outstanding text provides the sports medicine professional who is interested in the clinical use of sEMG with a solid introduction to the foundations of the neurophysiology of sEMG and the instrumentation, assessment, and proper application. Each chapter concludes with a series of multiple choice questions to facilitate learning. The book is well illustrated, particularly in the atlas. The language is clear and easy to understand, without being overly technical, and, as John Basmajian states in the foreword, "a spade is called a spade, but it is a shiny well-used spade and not an automated excavating system used by over-anointed writers." This book should take its place on the professional bookshelf of sports medicine professionals who use sEMG in clinical practice.

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Patient-Practitioner Interaction: An Experiential Manual for Developing the Art of Health Care

Carol M. Davis

Slack Incorporated, Thorofare, NJ

1998

3rd edition

305 pages

ISBN: 1-55642-400-0

Price: $32.00

This book renders a psychological depiction of the allied health care profession. The first section of this book references numerous psychological citations to "elder" psychiatrists. While most of this information could be retrieved from any undergraduate psychology text, the author presents the psychological constructs and their relevance to the health care profession. For example, chapter 6, on effective communication, would be useful in an introductory class for students entering the allied health care profession. Specifically, there is a need to acquire objective and subjective information to promote proper decision making that is in the best interest of the patient and athlete.

The book is divided into 2 sections: section I, "Awareness of Self," includes chapters on psychological constructs of self-awareness, values determination, and the identification process and resolution of moral dilemmas; section II, "Interacting with Others," encompasses chapters on effective helping, assertiveness, and effective communication. With reference to effective communication, the final chapters would be of particular interest for the health care practitioner. Specifically, chapters 12 and 13 involve communicating with persons having disabilities. In addition, chapter 14 concerns communications with terminally ill patients and their families.

The text would be suitable for an introductory athletic training course at the undergraduate level and as a secondary source in an undergraduate sports medicine class. However, to my knowledge, there are no courses specifically designed to cover this type of material. Many of the topics and issues presented in this text not only would be appropriate but also would be invaluable for a student entering the allied health care profession. For example, an introductory athletic training class could cover professional values (chapter 2) and effective communication (chapter 6). These issues should be addressed early in the clinical process of the student athletic trainer. As an educator, I believe it is important that we develop competent individuals with a strong desire to behave professionally and ethically. The first section of this text would also be useful in courses that are specifically designed to meet the needs of the education and counseling domain.

The exercises and illustrations are helpful in understanding the material. The exercises were creatively designed, and, after each chapter, I completed most of the exercises and found them useful for improving my clinical abilities. At $32.00, the cost of this text is comparable with similar psychology and allied health care books.

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Signs and Symptoms of Athletic Injuries

James B. Gallaspy and J. Douglas May
McGraw Hill, Blacklick, OH
1996
518 pages, illustrated
ISBN: 0-8151-4039-8
Price: $42.95

It is the authors' purpose for this textbook to be used as an illustrated guide to athletic injury nomenclature, as an adjunct to evaluation and medical referral. Although very thorough in content, the textbook is not intended to be all inclusive. However, since it includes all the injuries listed in the NATA Competencies, it would be a very good supplemental textbook. Even though the textbook is intended for the entry-level student, it would also be a good reference source for the certified athletic trainer, as well as the allied health professional.

The book is divided into 3 sections and 21 chapters, with an appendix of medical specialists. Each chapter is easily accessed by cross-referencing the colored tabs on the side of the book with the contents. The first section explains terminology used throughout the textbook, as well as the classifications of contusion, bursitis, strain, tendinitis, tenosynovitis, sprain, luxation, fracture, epiphyseal plate injury, and wounds. General signs and symptoms are listed, along with degrees of injury, if applicable. The second section, which consists of chapters 2–19, contains injuries that an entry-level student athletic trainer should know when taking the NATA-BOC certification exam. Each chapter is devoted to injuries associated with a particular body part. Chapter 2 covers head injuries, with the remaining chapters covering face, neck, shoulder, upper arm, elbow, wrist, hand, thorax, lower back, abdomen, hip, thigh, knee, lower leg, ankle, foot, and skin. All chapters include a specific description of the injury, including medical terminology, common terminology, mechanism of injury, symptoms, signs, special tests, referral/diagnostic procedures, and classification of injury. At the end of each of the injury chapters, a description of the specific evaluative tests for range of motion, muscular strength, ligament stability, neurology, and circulation are included. Chapter 20 includes general medical conditions such as appendicitis, rubella, insect bites, bronchitis, diabetes mellitus, and influenza. Specific descriptions and illustrations are included, if applicable. The last chapter, "Initial Management of Athletic Injuries," briefly describes the inflammatory process, the rationale for ice and compression, and the application techniques for ice packs. The appendix consists of a brief description of medical specialists used in the referral process, ranging from the allergist to the urologist. A bibliography and photograph credits are also included at the end of the book.

The overall content is very easy to follow. Legends to the illustrations are clear and specific. If a figure, x-ray, MRI, bone scan, CT scan, or arthroscopic view is used, the diagram is labeled with the names of the structures, shaded, or has arrows pointing to the intended area. The use of color photographs is very helpful in illustrating the signs associated with an injury, since it is often difficult for entry-level athletic training students to visualize an injury using only written descriptions of signs and symptoms. This textbook does a good job in combining written and visual descriptions. The only concern I have with the format of this textbook is that students may start using it as a "cookbook" for injury evaluation and referral, even though that was not the purpose intended by the authors.

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Functional Rehabilitation of Sports and Musculoskeletal Injuries

W. Ben Kibler, Stanley A. Herring, Joel M. Press, and Patricia A. Lee
The Rehabilitation Institute of Chicago Publication Series
Aspen Publishers, Gaithersburg, MD
1998
303 pages
ISBN: 0-8342-0612-9
Price: $79.00

This book may be most appropriate for the primary care physician interested in the field of sports medicine or as an adjunct for the master's-level student in athletic training. Prior knowledge of

anatomy, physiology, and injury would be needed to fully appreciate the material offered in this publication. The authors organized this text in a logical manner, answering "why," "what," and "how" questions regarding the rehabilitation of injured athletes. Overall, the authors present a thorough description of the rehabilitation process, and most chapters, although brief, are appropriately referenced. The first 3 chapters answer the "why" and "what" questions and include the authors' own concepts concerning the framework of why and what we rehabilitate. The physiologic basis of rehabilitation focuses mainly on muscle physiology, and the need to determine functional deficits is briefly addressed in these chapters. Chapter 4, which constitutes approximately 20% of the total text, provides the reader with extensive information on radiologic imaging. It includes many excellent photographs of magnetic resonance images and a few computed tomography scans of soft and bony tissue injuries. The chapter is extensively referenced and would be of value to a physician needing an update on the uses and interpretation of radiologic imaging. The appropriateness of this chapter is questionable, however, for a book focusing on functional rehabilitation. Chapters 5 and 6 address the use of medications and modalities, respectively. They are very brief overviews of each topic and would not be adequate as a guide for the application of these therapeutic measures. Although modalities are not the means to an end in rehabilitation, they are still valuable adjuncts to successful rehabilitation, and one might expect a more thorough inclusion of modality use in a book concerning the rehabilitation of sports and musculoskeletal injuries. Chapter 7, on flexibility, provides a scientific rationale for stretching, and although it briefly describes various stretching methods, it is not an adequate source for specific stretches for a given sport or body part. Chapter 8 addresses functional reconditioning and includes various return-to-sport exercises and drills, in narrative and photographic description. This chapter also is brief but useful for the reader interested in devising functional movement strategies. Chapter 9 provides a thorough look at the use of aquatics in rehabilitation and includes many photographs and helpful techniques for rehabilitation in the water. Chapters 10 through 20 constitute the majority of the text, over half the volume, and are devoted to the rehabilitation of regional body parts including cervical spine; shoulder; elbow; wrist and hand; lumbar spine; hip, pelvis, and thigh; leg (patellofemoral pain and overuse injuries); knee; ankle and foot; and foot alone. Overall, the information appears up to date, with a shared philosophy of pain-free, functional progression for return to sport.

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Sports Medicine for Young Athletes: A Guide for Parents, Teachers, and Coaches
Editor: Scott Kulstad, MEd, ATC/R
Fairview Press, Minneapolis, MN
1998
212 pages
ISBN:1-57749-066-5
Price: $14.95

Scott Kulstad and his contributing authors have made a unique and welcome contribution to the expanding volume of sports medicine literature with *Sports Medicine for Young Athletes: A Guide for Parents, Teachers, and Coaches*. There are few books dealing solely with the special issues of pediatric and adolescent athletes, and this is the first that I have encountered targeted toward parents and youth sport coaches. Taking a complicated subject and simplifying it for a well-meaning, but previously uninformed, audience can be a difficult task to accomplish. Kulstad and his contributors pull off this feat, but with a few hitches.

The book is divided into 2 sections: "The Basics" and "The Details." "The Basics" contains 5 chapters, 4 of which intend to provide a knowledge base for the topics discussed in the latter section. Chapter 1 begins with a simple and easy-to-understand anatomy overview. However, the author quickly begins mixing basic anatomy and physiology with athletic injuries and abnormal pathology. I think this may cause some early confusion and discouragement for lay readers. The second chapter's review of exercise, conditioning, and nutrition is far too superficial. These important issues are the foundation upon which injury prevention and physical fitness are built. Basic injury prevention (such as avoiding overtraining), teaching and practicing proper technique, appropriate weight training, avoidance of fad dieting, use of nutritional supplements, and the importance of properly rehabilitating injuries deserved a more thorough review in a book such as this one.

Chapter 3 reviews the evaluation, treatment, and prevention of injuries. Keeping in mind that this book is written for parents and coaches with little or no health care background, I was a bit shocked by the sentence, "When you are the first person to know about an injury, treating the injured child becomes your responsibility." No one without medical training should feel responsible for treating injuries! I don't think the author intends to put such responsibility on the reader, but, as the old saying goes, "a little knowledge can be dangerous." Throughout the book, a variety of "red flags" are mentioned as indications for immediate medical attention, and all are appropriate. However, more emphasis could have been placed on the fact that children are not "little adults" and that their injury patterns and mechanisms are different. As a pediatrician, I am all for the empowerment of parents regarding decisions about their children's health, and I encourage it on a daily basis. I am, however, concerned that some parents and coaches may misuse their newfound knowledge, not with malicious intent but out of ignorance.

The chapter detailing emergency procedures is excellent, giving good, practical tips and advice. However, it should be emphasized that the information in this chapter would be very difficult to understand and nearly impossible to put into practice without basic CPR certification. The final chapter in "The Basics" is "Issues for Girls and Women Only," which seems somewhat out of place. The discussions of amenorrhea, bulimia, and anorexia nervosa are outstanding and provide the reader with a good database. However, topics such as stress incontinence and pregnancy will be of little use to most readers. Anorexia nervosa and bulimia would have provided an excellent starting point for a further discussion

of psychological and emotional issues faced by young athletes.

The strength of this book lies in "The Details," which presents an overview of the most common sports- and recreation-related injuries suffered by young athletes. Chapters are organized by anatomical area. The contributing authors give a brief description of each injury, including common mechanisms, the anatomy of the injury, early recognition and treatment, and tips for rehabilitation. As previously mentioned, each chapter has a list of "red flags." The chapters end with a few frequently asked questions, highlighting clinical situations often encountered by those who regularly interact with young athletes and their parents.

This section provides a wealth of information for parents and coaches with little or no sports medicine background. In fact, athletic training students unfamiliar with young athletes and their injuries would greatly benefit from it as well. The recommendations for initial treatment of injuries will be helpful to many, if used with the utmost caution. I admire the effort to reduce wasted time and money in urgent care centers and emergency rooms and heartily endorse a quick phone call to the family physician or pediatrician "just to check if it could be serious." I think the true value of this text will be as a resource to parents and coaches after a diagnosis has been made by a physician or athletic trainer. All common conditions are explained in easy-to-understand language. I do think that this section of the book would benefit from a few more illustrations of the injuries and some simple rehabilitation exercises. The "red flags" are all appropriate and easily understood.

This book would make a valuable addition to the bookshelf of all coaches as well as any parent with a particular interest in sports injuries. The book does have some shortcomings, as I have already discussed. I would also like to see sections on exercise-induced asthma, cardiac sudden death, and the purpose of the preparticipation physical evaluation, all topics that are frequently subjects of parental and administrative concerns. Overall, however, Kulstad and his contributors have taken a difficult subject and put together a good, readable book, and, at $14.95, it's very affordable. It provides the reader with a solid foundation of knowledge that, if used properly, will lead to better injury care and safer sports participation for young athletes.

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The Sports Medicine and Athletic Training Patient Education Manual

Managing Editor: Sara Nell Di Lima; Senior Supervising Editor: Sandra Bloom Painter; and Research Editor: Donna M. Evans.

Aspen Publishers, Gaithersburg, MD
1998
235 pages plus appendices
ISBN: 0-8342-1078-9
Price: $169.00

The Sports Medicine and Athletic Training Patient Education Manual is a collection of materials recommended by physicians, certified athletic trainers, and physical therapists, organized into an attractive 3-inch, 3-ring binder. The editors state in their introduction that a carefully planned patient education program can be a key component for providing cost-effective quality care in today's climate of managed care and regulatory reform. Thus, this manual includes step-by-step patient instructions, definitions, discussions, assessment forms, questionnaires, exercise guidelines, and support resources.

The looseleaf manual is subdivided into 12 sections: 1) "The Sports Medicine Team," 2) "First Aid and Emergency Procedures," 3) "Injury Prevention," 4) "Injury Assessment/Evaluation," 5) "The Spine," 6) "Upper Extremity Injuries," 7) "Lower Extremity Injuries," 8) "Pain in Sports and Rehabilitation," 9) "Eating Disorders: The Clinical Condition," 10) "Sports Nutrition," 11) "Auxiliary Issues," and 12) "Appendixes" (including suggestions for medical kit contents and supply inventory).

The title of the book suggests that information included in this manual would be applicable for patient education; however, some documents are quite technical in their level of presentation and seem to be more pertinent for allied health care providers and general practitioners. Many of the articles have previously been printed in other forms of press, both peer reviewed and non-peer reviewed. As a result, the information tends to be quite individualized in approach, rather than following a standardized format throughout the manual. Some of the information is also outdated, and the appendix of sports medicine resources could benefit from a more up-to-date listing.

This manual would probably be best suited for a practicing clinician who works with patients on a regular basis. The information in the manual could be used by instructors of academic programs as a way of introducing students to various forms of patient education. However, I find it very difficult to recommend this manual, at the impractical cost of $169.00, as either a required or recommended classroom text. Much of the information can be found in other references that are commonly used by athletic trainers.

Since this document is intended as a patient education manual, I feel that some important content matter is missing. The addition of postoperative rehabilitation forms for common conditions (including precautions and contraindications), as well as information on ambulation and assistive device training, possible adverse effects associated with different forms of therapeutic intervention and modalities, and the multiple forms of reimbursement could strengthen the manual. An annual supplement is planned, for which the editors do invite contributions. The supplement will perhaps be the greatest strength of the manual and its format. Additions to the manual are also needed, because it is difficult to understand how the authors chose some pathologic topics, while excluding other very common ailments.

This manual is not recommended for the certified athletic trainer who already has customized patient education forms. However, because there may be some practicing certified athletic trainers who do not have access to, or have the time to develop, such forms, I would take advantage of the 30-day review period that the publishers extend to decide for yourself whether this manual would be a valuable investment.

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***Complete Conditioning for Tennis* (book and videotape)**
Paul Roetert
United States Tennis Association
Human Kinetics, Champaign, IL
1998
Book: 216 pages
Price: $15.95
Videotape: 28 minutes
Price: $24.95

Complete Conditioning for Tennis is an excellent book and videotape for professionals interested in sport-specific training for tennis. This book and videotape are most useful for tennis coaches who actually plan conditioning programs for tennis players, since the material focuses specifically on incorporating on-court drills to improve sport-specific fitness levels in tennis players. This material may also serve as an introduction for the strength and conditioning coach or athletic training professional who is new to working with tennis.

The first 2 chapters cover the physiologic demands of tennis and testing for tennis. These are followed by chapters on each of the major areas of emphasis for physical training in tennis: flexibility training, strength training, aerobic and anaerobic exercise, quickness and agility training, and ball and racquet drills. The next 2 chapters cover the basics of exercise program design and explain step by step how to design a conditioning program that is tennis specific. The final chapter discusses prevention of common tennis injuries to the wrist, elbow, shoulder, back, trunk, and knee.

Other subjects covered are injury prevention and resistance training for tennis. Since these items are covered at the coach's level of understanding, the materials are less useful to the certified strength and conditioning specialist and the certified athletic trainer, unless they are specifically involved in on-court drills for fitness in tennis players.

The book and videotape are complementary, and together they offer a comprehensive, sport-specific view of conditioning for tennis. By featuring actual demonstrations of the drills, the videotape gives both the coach and the player new ideas on sport-specific ways to improve fitness in tennis players.

This material is the most comprehensive and up-to-date information available on the topic. Not only does it cover all the components of a conditioning program, but it also provides sample programs that help the coach or athlete synthesize the information, including instructions for putting together the entire conditioning program. The cost of the materials is reasonable and comparable with the cost of similar materials currently available.

The book and videotape could serve as primary sources of information for tennis coaches who plan conditioning programs and for advanced tennis players who plan their own conditioning programs. As secondary sources, the book and videotape are useful for strength and conditioning professionals and athletic trainers who have a specific interest in tennis. The book is well organized and easily read and understood at the high school level and above.

This book and videotape would be excellent for certified tennis professionals who work with competitive tennis players. These materials could also serve as an introduction to tennis conditioning for certified strength and conditioning specialists and certified athletic trainers who are not familiar with tennis. Advanced junior players (and above) and adult players could use the information for planning their own conditioning programs. The tennis coach could benefit by using this information to plan conditioning and training programs for individual players.

This book will be most useful to individuals who work with tennis players on the court. Most of the conditioning exercises presented are on-court drills, many of which require the ability of the instructor to feed tennis balls, and this should be considered before purchasing this book and videotape. For individuals who do not work with players on court or are not able to feed tennis balls, this book and videotape will be of less benefit. On-court drills for tennis players are the ideal; conditioning should be sport specific. For individuals who are not involved in on-court tennis drills, it is still useful to understand sport-specific conditioning programs for tennis. Also, many of these drills and conditioning activities can be adapted to other sports that are mechanically or metabolically similar to tennis.

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ACSM Resource Manual for Guidelines for Exercise Testing and Prescription
Jeffrey L. Roitman
American College of Sports Medicine
Williams & Wilkins, Baltimore, MD
1998
3rd edition
715 pages
ISBN: 0-683-00026-8
Price: $49.95

The *ACSM Resource Manual for Guidelines for Exercise Testing and Prescription*, 3rd edition, should be the primary reference source for all health/fitness and clinical professionals. A major purpose of this text is to continue being the resource behind another publication entitled *ACSM Guidelines for Exercise Testing and Prescription.* This authoritative source provides the information necessary for the health/fitness professionals who are candidates for ACSM certifications, as well as for individuals presently in the health/fitness or the clinical environment. Instead of the original behavioral objectives, this edition describes a set of minimum competencies for various levels of certification, using the terms *knowledge, skills,* and *abilities* on 2 different tracks, the health/fitness track and the clinical track, and each specific certification within that track. A major drawback of this edition is that the listings do not include those necessary for relatively new certifications, such as the "Advanced Personal Trainer," "Exercise and the Older Adult," and "Nutrition and Physical Activity."

In the front of this unique manual, the listings are provided exactly like those in the *Guidelines for Exercise Testing and Prescription*, identifying each certification track with the corresponding chapter numbers in the *Resource Manual.* However, in the *Resource Manual* they are in consecutive order, and in the *Guidelines* they are not, which can be awkward when the two are used for cross-referencing.

This edition has shortened the chapters in order to concentrate on the material and make it easier to find. This *Resource Manual* edition provides the core material with

the latest research in a very broad preventive and rehabilitative exercise area, including lifestyle and health, anatomy and biomechanics, exercise physiology, coronary artery disease and other chronic diseases, electrocardiography, exercise programming, human development, behavior modification, and program management. Helpful appendices include a compendium of physical activity with a metabolic equivalent table, a position statement on bloodborne pathogens, and a resource list of generic and brand names of common medications.

This softcover resource book is a must for all certification candidates and health/fitness and clinical professionals. The cost is very reasonable for a text of this caliber.

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Therapeutic Modalities
Chad Starkey
FA Davis, Philadelphia, PA
1998
2nd edition
397 pages
Price: $41.00

Therapeutic Modalities, 2nd edition, provides a comprehensive survey of the use of therapeutic modalities in the treatment of orthopaedic injuries. The book is divided into 2 distinct parts. The first 3 chapters provide an overview of the physiologic responses to injury, the perception of pain, and the role of clinical decision making in integrating modalities for a comprehensive treatment plan. The last 4 chapters of the book detail the clinical applications of thermal agents, electrotherapy, ultrasound, and mechanical modalities.

The first section of this book is particularly informative. Chapter 1 provides a thorough overview of the structure and function of different body tissues and details the inflammatory and healing responses to injury. Dr. Barton Buxton's chapter on pain describes the contemporary theories of pain sensation and control, as well as methods of pain assessment and individual differences in pain perception. Although this chapter is very well written, a more thorough discussion of chronic pain syndromes, such as reflex sympathetic dystrophy and fibromyalgia, would be helpful. Jeff Ryan's chapter on clinical decision making is the book's strongest chapter, tying together goal setting with the stages of inflammation and healing, modality application, and therapeutic exercise. Three unique case studies provide the theoretical rationale for integrating specific modalities into treatment plans for different orthopaedic injuries.

The chapters covering individual modalities present the physiologic effects of the respective modalities on injured tissues, the theoretical rationale for using each modality, and guidelines for the clinical application of each modality. These chapters are well referenced and attempt to provide a scientific basis for the use of the therapeutic modalities. The chapters on thermal agents and ultrasound are particularly strong; however, I found the chapter on electrotherapy to be rather unwieldy. The author provides a lengthy description of the principles of electricity without drawing an immediate parallel to the effect of electricity on body tissues. Once the application of specific electrical agents is discussed, however, the rationale and guidelines for clinical use are adequately presented. The chapter on mechanical modalities examines intermittent compression units, traction, massage, and biofeedback. While therapeutic massage is presented in this text, other manual therapy techniques such as joint mobilization, strain/counterstrain, and muscle energy are not discussed. I felt the biofeedback section might have been better suited for inclusion in the chapter on electrotherapy.

Appendixes cover trigger points, motor points, medical shorthand, and physical properties governing therapeutic modalities. The reader is referred to these appendixes at appropriate points throughout the text. A comprehensive glossary of terms and a thorough index also highlight this book. Additionally, the numerous illustrations and figures are a useful adjunct to the text.

This text is an improvement on the original edition and would be best suited for use in an upper-level undergraduate or graduate-level course in therapeutic modalities directed at athletic training or physical therapy students. Rehabilitation professionals would also find this book helpful as a reference text for the efficacy of therapeutic modalities in the treatment of orthopaedic injuries. The book is reasonably priced and comparable with other currently available texts on modalities.

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Current Literature

Clint Thompson, MS, ATC

CREATINE

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1999 REQUEST FOR PROPOSALS

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

Research Grants

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

I. General Grants

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

II. Pediatric Sports Health Care

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

Background

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

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

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

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

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

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

Objectives

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

III. Doctoral Research Grants

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

Applicants must be current certified member of the NATA. You must be a doctoral student at the institution where the research is to be performed and have doctoral student status during the term of the grant to be considered for funding.

Larger-Scale Projects

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

Application Procedure

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

NATA Research & Education Foundation

CALL FOR ABSTRACTS

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

Nashville, Tennessee • June 29 - July 2, 2000

DEADLINE FOR ABSTRACT SUBMISSION: JANUARY 5, 2000

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

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

FREE COMMUNICATIONS ABSTRACTS

Specific Content Requirements

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

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

Instructions for Preparing the Abstract

1. Provide all information requested on the Abstract Author Information Form. Abstracts should be typed or word processed using a **letter-quality** printer with no smaller than elite (12 cpi) or 10-point typeface. Do not use a dot matrix printer.
2. Top, bottom, right, and left margins should be set at 1.5" using a standard 8.5" x 11" sheet of paper. Type the title of the paper or project starting at the left margin.
3. On the next line, indent 3 spaces and type the names of all authors, with the author who will make the presentation listed first. Type the last name, then initials (without periods), followed by a comma; continue with the other authors (if any), ending with a colon.
4. Indicate the institution (including the city and state) where the research or case report was conducted on the same line following the name(s) of the author(s).
5. Double space and begin typing the text of the abstract flush left in a single paragraph with no indentions. Do not justify the right margin. Do not include tables.
6. The abstract must **not** exceed 400 words.

CLINICAL CASE REPORTS

Specific Content Requirements

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

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

Instructions for Preparing the Abstract

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

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

NATA Research & Education Foundation Call for Reviewers

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

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

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

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

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

Responses preferred by December 1, 1999

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

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

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

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

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

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Indicate the most appropriate TYPE for the presentation: *(check one only)*
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❑ Observation/Informational Studies

Indicate your presentation preference:
(check one only; choice does not influence acceptance)
❑ Poster ❑ Oral ❑ Indifferent

Thanks...

Thank You to Our 1998 Manuscript Reviewers

Many thanks to all our 1998 Guest Reviewers. Special thanks to retiring Editorial Board members Martyn H. Bradley, MS, ATC; Deloss A. Brubaker, EdD, ATC; Richard G. Deivert, PhD, ATC; Robert J. Moore, PhD, RPT, ATC; and Thomas G. Weidner, PhD, ATC, for their many years of dedicated service to the *Journal*.

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Authors' Guide

(Revised January 1999)

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complaint, history of present complaint (including symptoms), results of physical examination (example: "Physical findings relevant to the rehabilitation program were . . ."), medical history (surgery, laboratory results, exam, etc), diagnosis, treatment and clinical course (rehabilitation until and after return to competition), criteria for return to competition, and deviation from expectations (what makes this case unique).

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Percentages should be accompanied by the numbers used to calculate them.

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    Journals:
    1. van Dyke JR III, Von Trapp JT Jr, Smith BC Sr. Arthroscopic management of postoperative arthrofibrosis of the knee joint: indication, technique, and results. *J Bone Joint Surg Br.* 1995;19:517–525.
    2. Council on Scientific Affairs. Scientific issues in drug testing. *JAMA.* 1987;257: 3110–3114.

    Books:
    1. Fischer DH, Jones RT. *Growing Old in America.* New York, NY: Oxford University Press Inc; 1977:210–216.
    2. Spencer JT, Brown QC. Immunology of influenza. In: Kilbourne ED, Gray JB, eds. *The Influenza Viruses and Influenza.* 3rd ed. Orlando, FL: Academic Press Inc; 1975:373–393.

    Presentations:
    1. Stone JA. Swiss ball rehabilitation exercises. Presented at the 47th Annual Meeting and Clinical Symposia of the National Athletic Trainers' Association; June 12, 1996; Orlando, FL.

    Internet Sources:
    1. Knight KL, Ingersoll CD. Structure of a scholarly manuscript: 66 tips for what goes where. Available at http://www.nata.org/jat/66tips. html. Accessed January 1, 1999.
    2. National Athletic Trainers' Association. NATA blood borne pathogens guidelines for athletic trainers. Available at http://www.nata.org. Accessed January 1, 1999.
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