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### Feature Articles

<table>
<thead>
<tr>
<th>Title</th>
<th>Authors</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory Information Can Decrease Cold-Induced Pain Perception</td>
<td>Stephen Streator, MA, ATC, Christopher D. Ingersoll, PhD, ATC, and Kenneth L. Knight, PhD, ATC</td>
<td>293</td>
</tr>
<tr>
<td>A Comparison of Anterior Knee Laxity in Female Intercollegiate Gymnasts to a Normal Population</td>
<td>Tori L. Brannan, MS, ATC, Shane S. Schultheis, PhD, ATC, LPT, J. William Myrer, PhD, and Earlene Durrant, EdD, ATC</td>
<td>298</td>
</tr>
<tr>
<td>Rate of Temperature Decay in Human Muscle Following 3 MHz Ultrasound: The Stretching Window Revealed</td>
<td>David O. Draper, EdD, ATC and Mark D. Ricard, PhD</td>
<td>304</td>
</tr>
<tr>
<td>Acute Exertional Rhabdomyolysis and Its Relationship to Sickle Cell Trait</td>
<td>Gary L. Harrelson, EdD, ATC, A. Louise Fincher, EdD, ATC, and James B. Robinson, MD</td>
<td>309</td>
</tr>
<tr>
<td>A Comparison of Isokinetic and Isotonic Predictions of a Functional Task</td>
<td>Mitchell L. Cordova, MA, ATC, Christopher D. Ingersoll, PhD, ATC, John E. Kovaleski, PhD, ATC, and Kenneth L. Knight, PhD, ATC</td>
<td>319</td>
</tr>
<tr>
<td>Liver Laceration in an Intercollegiate Football Player</td>
<td>Richard Ray, EdD, ATC and James E. Lemire, MD</td>
<td>324</td>
</tr>
<tr>
<td>The Performance Enhancement Group Program: Integrating Sport Psychology and Rehabilitation</td>
<td>Vincent J. Granito, Jr, MA, Jeffrey B. Hogan, ATC, and Lisa K. Varnum, ATC</td>
<td>328</td>
</tr>
<tr>
<td>1995 Student Writing Contest Winner</td>
<td>Glenohumeral Joint Impingement in Swimmers</td>
<td>333</td>
</tr>
<tr>
<td>Portfolios: An Alternative Method of Student and Program Assessment</td>
<td>Susan E. Hannam, HSD, ATC, CHES</td>
<td>338</td>
</tr>
<tr>
<td>Surgical Treatment of Chronic Patellar Tendinitis in a Collegiate Football Player</td>
<td>Joel W. Beam, MEd, Philip R. Lozman, MD, ATC, and John W. Uribe, MD</td>
<td>342</td>
</tr>
<tr>
<td>An Alternative Material for Silicone Casting</td>
<td>James M. Sabo, EdD, ATC</td>
<td>345</td>
</tr>
<tr>
<td>Teacher Certification Among Athletic Training Students</td>
<td>Neil Curtis, EdD, ATC</td>
<td>349</td>
</tr>
<tr>
<td>Refocusing the Adolescent Preparticipation Physical Evaluation Toward Preventive Health Care</td>
<td>Michael C. Koester, ATC</td>
<td>352</td>
</tr>
<tr>
<td>Septic Arthritis in a Collegiate Football Player</td>
<td>James A. Madaleno, MS, ATC, Jeffrey R. Allen, MEd, ATC, and Kurt E. Jacobson, MD</td>
<td>361</td>
</tr>
</tbody>
</table>

### Departments

<table>
<thead>
<tr>
<th>Department</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>18th Annual Student Writing Contest</td>
<td>337</td>
</tr>
<tr>
<td>Abstracts</td>
<td>363</td>
</tr>
<tr>
<td>1996 Request for Proposals NEW-Education Grants!</td>
<td>368</td>
</tr>
<tr>
<td>Call For Abstracts</td>
<td>369</td>
</tr>
<tr>
<td>New Products</td>
<td>371</td>
</tr>
<tr>
<td>Current Literature</td>
<td>373</td>
</tr>
<tr>
<td>CEU Quiz</td>
<td>375</td>
</tr>
<tr>
<td>Authors’ Guide</td>
<td>377</td>
</tr>
<tr>
<td>Thanks</td>
<td>378</td>
</tr>
<tr>
<td>Author/Subject Indexes</td>
<td>380</td>
</tr>
<tr>
<td>Advertisers’ Index</td>
<td>384</td>
</tr>
</tbody>
</table>
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Sensory Information Can Decrease Cold-Induced Pain Perception

Stephen Streator, MA, ATC; Christopher D. Ingersoll, PhD, ATC; Kenneth L. Knight, PhD, ATC

ABSTRACT: Specific terms are often used to describe the pain athletes typically experience during cold treatments. It is not clear whether providing athletes with such descriptive sensory information will decrease their perceived pain during treatments. The purpose of this study was to determine if subjects’ perceptions of cold-induced pain could be influenced by the type of information provided before treatment, such as “pain will be crushing” or “pain will be flickering.” Ninety Division I intercollegiate athletes were randomly assigned to one of five groups: traditional terms (cold, burning, aching, numbness), high-level terms (freezing, crushing, pounding, heavy), moderate-level terms (cold, gnawing, pulsing, aching), or low-level terms (cool, pinching, flickering, dull) from the McGill Pain Questionnaire, or no terms at all (control). The four groups that received a set of terms were told that those terms described the sensations they would feel during cold immersion of the ankle. Pain was measured with the McGill Pain Questionnaire every 3 minutes during a 21-minute immersion (1°C) of the foot and ankle. Sensory, affective, evaluative, and miscellaneous pain measures were derived. The control group experienced greater sensory and affective pain than did any of the other groups and experienced greater evaluative pain than did the groups receiving low-level or traditional terms. We conclude that providing athletes with some type of sensory information to describe their cold-pain experience will decrease their perceived pain during cold immersion, although it does not seem to matter what terms are used.

The benefits of cold applications during sports injury rehabilitation are well documented. However, most athletes who have experienced cryotherapy for the first time report that the treatment was rather uncomfortable, thus reducing their willingness to comply with follow-up treatments, and consequently prolonging rehabilitation. Pain perception can be reduced by imagery and distraction. Clinicians have attempted to reduce cold pain by suggesting sensations that athletes could expect to feel. Authors have used four terms to describe the sensations felt during cold treatments: an initial feeling of cold, followed by burning, aching, and analgesia. Are these terms indeed effective? Could other terms be as, or more, effective?

Heretofore there has been no information about what type of terms to use when attempting to help athletes cope with ice water pain. The purpose of this study was to determine if presenting traditional terms or terms from the McGill Pain Questionnaire that represent varying levels of pain would have an effect on athletes’ pain perception during cold water immersion.

METHODS

The independent variable for this study was the descriptive terminology given to the subject before treatment; its levels included: low-level terms, moderate-level terms, high-level terms, traditional terms, and a control that received no terms. The dependent variables were the scores of sensory, affective, evaluative, and miscellaneous pain. Previous studies in this area have primarily focused on the intensity component of pain and have paid little attention to the sensory or affective components described by Melzack. Ninety varsity track athletes (54 men, 36 women) volunteered as subjects for this study. Subjects had not been exposed to cryotherapy for at least 1 month before the testing session, and did not have any current orthopedic, neurological, or vascular injuries to the lower extremities. Informed consent was obtained from each subject before participation.

Part II of the McGill Pain Questionnaire was used to measure the cold-pain experience. It was modified by replacing the word “pain” with the word “sensation” in the instructions. This instrument has been shown to be both valid and reliable. Part II of the questionnaire consists of 20 categories, each containing terms describing painful sensations. Categories 1 through 10 describe the sensory component of pain, sensations of temporal, spatial, pressure, or thermal properties; categories 11 through 15 describe the affective component of pain, tension or fear; category 16 describes the evaluative component, which is an overall intensity measure; and categories 1 through 20 describe miscellaneous pain.

For the ice immersion, we used a 3-gallon bucket of ice and water with an initial temperature of 1°C, but made no attempt to maintain that temperature in order to simulate a real treatment scenario.

Subjects were randomly assigned to one of five groups. The treatment of groups differed by the terms they were given before ice water immersion.

The terms used for each group were as follows:

- Group One (low-level terms)—“cool, pinching, flickering, dull.”

Stephen Streator was a graduate assistant at Indiana State University at the time of this study.
Christopher D. Ingersoll is an associate professor in the Athletic Training Department at Indiana State University, Terre Haute, IN 47809.
Kenneth L. Knight is a professor and chairperson of the Athletic Training Department at Indiana State University.
• Group Two (moderate-level terms)—“cold, gnawing, pulsing, aching.”
• Group Three (high-level terms)—“freezing, crushing, pounding, heavy.”
• Group Four (traditional terms)—“cold, burning, aching, numbness.”
• Group Five (control)—no terms were given.

Before being tested, subjects were familiarized with the content of the McGill Pain Questionnaire and instructed to only select the terms that applied to the sensations they were feeling. Also before testing, a medical history was taken in an effort to uncover any pre-existing orthopedic or neurological problems.

The instructions given to the subjects were audiotaped so that the only difference in their instructions was the terms suggested to describe their pain. This was an effort to eliminate as many confounding variables as possible. Each subject was tested individually to prevent any “audience effect” or other communication of sensory information.

The athletes then commenced testing by placing their right foot and ankle into the ice water. Every 3 minutes during the immersion, they were given the McGill Pain Questionnaire to complete. Treatment continued for a total of 21 minutes. Questionnaires were collected after each time interval. Every effort was made to control external sources of distraction; no conversation, reading, or writing was allowed. Thus, subjects had to concentrate on the feelings they were experiencing as influenced by the terms they were given. After being tested, the subjects were given a Previous Cold-Pain Questionnaire regarding their previous experiences with cold therapy, such as frequency of application, whether they were given information about what sensations to expect, etc.

We focused on the level of responses in the sensory component (McGill Pain Questionnaire categories 1 through 10), affective component (categories 11 through 15), evaluative component (category 16), and miscellaneous component (categories 17 through 20). Each descriptor was numbered in accordance with its level of magnitude. A score of 1 is considered the most benign, while the higher scores are more severe. A total score was computed for each category by summing all seven McGill Pain Questionnaire administrations. Thus, a higher total categorical score indicated an increased level of pain experienced by the subjects during cold immersion.

Univariate F-tests and the Newman-Keuls test were used for analysis. The probability was set at $p < .01$ for all tests following a Bonferroni correction.

### RESULTS

All 90 varsity athletes completed this study. The means and standard deviations of pain perception are in the Table. There was a significant treatment effect among the groups. Subjects in the control group experienced more sensory ($F(4,85)=3.37$, $p=.01$) and affective ($F(4,85)=3.62$, $p=.009$) pain than subjects in the four treatment groups (those given low-level terms, moderate-level terms, high-level terms, and traditional terms). However, there were no differences among the groups given sensory information.

For the evaluative component, the control group differed from groups receiving low-level and traditional terms, but not from groups receiving moderate-level or high-level terms ($10.8 \pm 7.1, F(4,85)=3.36, p=.01$). Again, there were no differences among the experimental groups.

There were no differences among any of the groups for miscellaneous pain ($F(4,85)=2.34, p=.06$).

Four of the 90 subjects (4.4%) never had an ice treatment that they could remember. Those who had previous cold exposure reported that many different forms of cold treatment had been used, often in conjunction with each other. Thirty-seven of the 86 subjects (43.0%) who had previously had an ice treatment said they had had more than 50 cold treatments in their careers, while 10 (11.6%) remembered having had fewer than 10 treatments. On average, they had cold applied twice a day while their condition persisted. Sixty-five (76%) of the subjects had a strong previous experience with cold (20 or more ice treatments). These subjects were evenly dispersed among the five treatment groups.

Before this study, 19 of the 86 subjects who had previously had an ice treatment (22.1%) had received terms describing what they could expect to feel. Those who did receive this information said that, in general, there would be approximately 5 minutes of discomfort followed by a period of relative numbness. According to their responses to question 10 of the Previous Cold-Pain Experience Questionnaire, 75 of the subjects (87.5%) felt that the terms we gave them before immersion agreed with their previous experiences and expectations, regardless of their group membership. The subjects who disagreed were spread out evenly over the four treatment groups. Whether they were low- or high-level terms did not seem to make a difference.

Nine of the 72 subjects (12.5%) who received verbal instructions responded that our instructions before the immersion changed their expectations, mostly causing them to have a...
better understanding of the process and to feel more relaxed during the treatment. None of the 18 subjects in the control group (no sensory information) reported that their perceptions of cold had changed as a result of this study. Sixteen of the 72 subjects (22.2%) in the other four groups felt that their perceptions had changed.

Those athletes who were told that they would eventually experience numbness (traditional terms), circled numbness 11% more than those receiving low-level terms, 21% more than those receiving moderate-level terms, 33% more than those receiving high-level terms, and 38% more often than those not receiving any information (control).

DISCUSSION

Weisenberg\(^{23}\) reported that “pain and anxiety have been associated with each other. ...the greater the anxiety, the greater the pain.”\(^{11}\) Other researchers\(^{14,22,25}\) demonstrated a reduction in anxiety when subjects were given sensory information. Thus, if athletes are given sensory information about the noxious stimulus they are about to receive, perception of pain is decreased.\(^{12}\) Our results support the idea that providing athletes with some form of verbal sensory information before cold therapy reduces sensory, affective, and evaluative pain when compared with athletes who are not provided with sensory information. Terminology and intensity levels did not matter. Clearly, emotional distress may be reduced regardless of what subjects are told.\(^{8,12}\)

The intensity level of the terms had no effect on the subjects’ sensory pain. However, there does seem to be a benefit to sensitizing them with terms as opposed to not doing so. A possible explanation for this may be that most athletes at this level have already had a fair amount of previous cold experience, which, if they received no coping strategies or sensory information beforehand, may have caused them to form their own opinions of what cold feels like. The subjects may have developed or retained sensory information that emphasized pain from their first ice treatment and used that as their sensory information.\(^{12}\) If the athlete already expects the stimulus to be painful, distress or anxiety is much harder to decrease.\(^{9}\)

Likewise, affective pain was unaltered by the terms that were given; however, those who were not given terms also exhibited a greater degree of apprehension. It seems that as long as the athletic trainer has told them something, they felt that they knew what to expect and their state of apprehension was lowered. This agrees with Weisenberg\(^{23}\) who claimed that “the concept of fear of pain has been proposed as a key element to explain an exaggerated response to pain.” Those subjects with more previous cold experiences reported less pain than those who had relatively fewer treatments. This supports the notion that college athletes’ personal cold experiences tend to play a major role in cold-induced pain perception.

Evaluative pain responses were not different among the four treatment groups, indicating that these subjects experienced a similar overall pain intensity. The control group had a significantly higher pain response than some of the treatment groups, which supports the idea that sensory information can be a useful tool in decreasing the perceived intensity of cold pain.

Surprisingly, only 12% of the subjects claimed that our terms had changed their expectations. Based on these responses and the average pain scores, it seems that athletes’ perceptions of the cold may be influenced, yet most do not seem to be aware that this is happening. Those who did report a change in perception claimed that they were able to concentrate more on the sensations they were feeling because they had an idea of what was going to happen next. Even though it has been suggested that numbness is questionable in subjects deprived of any sensory information,\(^{12,13}\) it seems that telling them to expect numbness may actually cause them to describe their experience as numbness.

Ingersoll and Mangus\(^{13}\) reported that total analgesia or “lack of pain” did not occur during a 21-minute ice immersion and recommended use of the term “hypalgesia.” Although the athletes circled the term “numb” often in this study, we question whether sensation had disappeared altogether due to the fact that no subjects chose it as the only term they felt. They always circled another term along with the numbness. In addition, all subjects continued to select pain terms throughout immersion. This indicates that total absence of pain never occurred and supports use of the term “hypalgesia.” All but two subjects (98%) reported that the questionnaire accurately described their sensations. Promise of a minimal pain experience resulted in less pain than a promise of a more severe pain experience.

The clinical implications of this study are that even though athletes may have had previous experience with cold, some form of sensory information before treatment will act as a modifier to what they will experience. Pain will be less when compared to not giving any sensory information, even in subjects with previous experience with cold. We need to incorporate this more often when using cold treatments in rehabilitation procedures. This will improve the chances that the athlete will complete follow-up treatments, thus promoting prompt return to activity.

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A Comparison of Anterior Knee Laxity in Female Intercollegiate Gymnasts to a Normal Population

Tori L. Brannan, MS, ATC; Shane S. Schulthies, PhD, ATC, LPT; J. William Myrer, PhD; Earlene Durrant, EdD, ATC

ABSTRACT: Increased joint laxity may predispose an individual to ligamentous injury. Female gymnasts have a high incidence of ligamentous injury, including the anterior cruciate ligament (ACL). Previous authors have found a relationship between ACL disruption and preexisting ligament laxity. The purpose of this study was to compare anterior knee laxity in the knees of female intercollegiate gymnasts with those of a normal female population. A secondary purpose was to measure genu recurvatum and assess the relationship between it and anterior laxity of the knee. We tested 30 gymnasts and 30 control subjects having no history of ACL injury with the KT-1000 knee arthrometer. The quadriceps active, 133 N (30 lb) anterior drawer, and manual maximum tests were performed on the subjects’ right knees along with goniometer measurements. Using a two-way analysis of variance (ANOVA) with repeating measures, we detected a significant increase in anterior laxity when comparing the 133 N to the manual maximum test, but no significant difference between gymnasts and nongymnasts. We concluded that gymnasts, as a group, are not abnormally lax when compared to an active population of similar age. Future comparison of the longitudinal data of those who incur ACL injury during their gymnastics careers may show whether individuals with increased laxity have increased risk of ligamentous injury.

METHODS

Our project consisted of three parts: 1) subject selection: normal and intercollegiate gymnasts, 2) subject questionnaire, and 3) test measurement.

Normal subjects were 30 female volunteers (age = 19.4 ± 1.7 yr, wt = 59.6 ± 7.8 kg, ht = 1.7 ± .06 m) participating in physical education activity courses at BYU. Subjects reporting current or previous participation in intercollegiate athletics or club gymnastics were removed from the study. Thirty female volunteers (age = 19.9 ± 1.7 yr, wt = 56.7 ± 6.5 kg, ht = 1.6 ± .05 m) from three NCAA Division I women’s gymnastics teams served as intercollegiate gymnast subjects. Mean number of years in gymnastics competition was 12.7 ± 2.6 yr. Data were collected at the beginning of daily practice.

We obtained signed informed consents, and all subjects reported having no knee pain or history of an ACL disruption or reconstruction, and all had active pain-free range of motion of the knee being measured.

All subjects received and completed a questionnaire concerning age, height, weight, previous exercise that day, and previous injuries requiring medical attention to either or both knees (see Figs 1 & 2). The dates and types of injuries were reconstructed, or partially disrupted knee. We asked gymnast volunteers additional questions, such as number of years in gymnastics and highest level of competition.

We measured the knee laxity of each subject with the MEDmetric Knee Arthrometer model KT-1000 (MEDmetric Corporation, San Diego, CA). The KT-1000 has been shown to be valid and reliable in measuring anterior knee laxity.

Testing order was: quadriceps active test (to screen for abnormal...
Name __________________________ Age __________

Height __________________________ Weight __________________________

Number of years in gymnastics training __________________________

Highest level you competed in. Circle.

Elite Class 10 Class 9 Class 8 Class 7 Class 6 Class 5

List the events in which you have competed. __________________________

Have you ever had an injury to your knees that has required medical attention? YES or NO

If YES, what injury and when? __________________________

RIGHT or LEFT knee? __________________________

Have you exercised rigorously within the last 5 hours? YES or NO

Rank the following events with regard to your perception of physical strain on your knees. Use numbers 1-4 with 1 causing the most strain and 4 the least amount of strain on your knees.

__floor exercise __vault __balance beam __uneven bars

Indicate the frequency with which your knees hurt.

rarely sometimes often frequently

Fig 1. Gymnasts' questionnaire.

mal posterior laxity), the 133 N (30 lb) anterior drawer test, and the manual maximum test.

We conducted the quadriceps active test with the subject supine and the knee joint at 90° of flexion, according to Daniel and Stone. Subjects extended their knees with the examiner preventing the foot from moving, thus producing an isometric contraction of the quadriceps. Anterior tibial translation of >1 mm signifies abnormal posterior laxity. Subjects exhibiting a positive quadriceps active test were informed of the finding and released from the study. We conducted the remainder of the testing in accordance with the established procedures of Daniel and Stone, and Fukubayashi et al.

Following the KT-1000 testing, we measured the subjects' genu recurvatum with a 12-inch manual goniometer. Subjects maintained the supine position with the touch fastener (Velcro) strap secured and their heels resting on the thigh support of the KT-1000. We centered the fulcrum of the goniometer over the lateral femoral epicondyle. The proximal arm was aligned with the lateral midline of the femur, using the greater trochanter as a reference, and the distal arm with the lateral midline of the fibula, using the lateral malleolus as a reference point.

We calculated the mean anterior translation of the three trials, for the 133 N (30 lb) anterior force and the manual maximum tests, rounded to the nearest 0.5 mm, and recorded it as the dependent variable. Our independent variables consisted of the normal population vs the gymnast population, and the 133 N (30 lb) anterior force vs the manual maximum force. We used a repeated measures two-way analysis of variance (ANOVA) to test for differences at the p = .05 level of significance. Sphericity was verified.

RESULTS

Individual cell means and standard deviations of anterior laxity in gymnasts and nongymnasts are reported in the Table. We found no significant difference in anterior laxity between the gymnasts and controls (F(1,58) = 1.04, p = .31). Power for the critical value of 2-mm difference between gymnasts and controls was .958. As expected, there was a significant difference between the 133 N anterior drawer and the manual maximum test (F(1,58) = 20.9, p = .0001). There was a low correlation (r = .35) in both gymnasts and controls between genu recurvatum and anterior knee laxity.

DISCUSSION

An athletic trainer's role includes the prevention, care, and rehabilitation of athletic injuries. Through skillful observation and deduction, possible predisposing factors for injuries be-

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<thead>
<tr>
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<th>N</th>
<th>133N</th>
<th>Man Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gymnasts</td>
<td>30</td>
<td>8.2 ± 2.4</td>
<td>8.8 ± 1.7</td>
</tr>
<tr>
<td>Control</td>
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<td>7.4 ± 2.2</td>
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</tr>
</tbody>
</table>
come apparent. Joint laxity has been found to be a possible predisposing factor for ACL injury. Forster et al⁸ found that the uninjured knee in ACL-injured patients had greater laxity than the average laxity of the knee in the normal subjects measured. They suggest that perhaps the injured knees were already relatively lax before the injury and therefore more susceptible to further damage. A study of 675 male soldiers of the same age (17 years) and on the same physical exertion regimen also supports this idea. The authors⁵ found that those who were classified as lax, or hyperlax, had significantly more musculoligamentous lesions, particularly in the ankle and knee. They believe that these results confirm that joint hyperlaxity predisposes individuals to musculoligamentous lesions. Nicholas²⁰ found that 72% of professional football players who exhibited at least 3 out of 5 indices of looseness ruptured either a collateral or cruciate ligament. However, other authors in subsequent studies have not been able to replicate his findings.¹⁷,²⁵

Studies using the KT-1000 have evaluated the immediate and long-term effects of exercise on anterior tibial-femoral laxity. Short-term, these studies differed by demonstrating either an acute increase or the appearance to have no effect on measured anterior laxity.¹²,²³,²⁶,²⁷ Concerning the long-term effect, Chandler et al³ showed no increase in knee laxity in individuals engaged in an 8-week squat training program, as did Steiner et al²⁶ with power lifters performing repetitive squats. Chandler found further that power lifters and weight lifters had decreased joint laxity when compared to controls. Gymnastics incorporates extreme flexibility with long-term, high-level training and competition. To our knowledge, this is the first study that has attempted to evaluate the effect of long-term gymnastics competition on anterior knee laxity and genu recurvatum. We proposed that increased flexibility increases laxity; however, this is not the case. We conclude that long-term gymnastics competition (12.7 ± 2.6 yr) does not produce significant changes in anterior knee laxity when compared to an active population of similar age. While gymnastics participation does not appear to increase anterior knee laxity in general, we cannot conclude whether increased knee laxity predisposes an individual for injury. We chose to look at gymnasts generally. Prospective, longitudinal studies are needed comparing the injury rates of lax individuals with those of less lax individuals in order for injury risk to be identified.

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Fig 2. Application of ultrasound to a subject's triceps surae muscle.

to go from its peak to original baseline temperature. Once the temperature reached the original baseline reading, it continued to drop another 0.7 ± 0.5°C at a rate of 0.08 ± 0.05°C per minute until it stabilized. On average, the temperature posttreatment dropped 0.8 ± 0.56°C below the original baseline.

We ran a stepwise nonlinear regression analysis to predict temperature decay as a function of time following ultrasound treatments. We found a significant nonlinear relationship between time and temperature decay \( r = .99, r^2 = .99, SE \text{ of estimate} = .06 \). We obtained the following prediction equation:

\[
TD = -.60321(t) + .02466(t)^2 - .000375(t)^3 - .24404
\]

Where TD = temperature decay and t = time.

The rate of temperature decay is displayed in Figure 3. Notice that the temperature begins to drop quite rapidly, and then slows down before reaching baseline. The average time it took for the temperature to drop each degree, as expressed in minutes and seconds is as follows: 1°C = 1:20; 2°C = 3:22; 3°C = 5:50; 4°C = 9:13; 5°C = 14:55; 5.3°C = 18:00 (baseline).

**DISCUSSION**

The care and treatment of contractures due to scar tissue, adhesions, tight capsules, and fibrotic muscle/tendon presents a major obstacle. The ability for connective tissue to elongate is contingent on the amount of interweaving between the meshwork of its collagen fibers. Fibers with few interweavings allow a greater ROM than do fibers with many interweavings, such as scar tissue or dense connective tissue. Separation of adjacent collagen fiber attachments within the connective tissue meshwork hypothetically allows for a long-lasting elongation.

When stressed, collagenous tissue is fairly rigid; yet, when heated, it becomes much more yielding. However, the combination of heat and stretch produces a residual lengthening of connective tissue, which increases according to the force applied. The greatest lasting increase in the length of tissue has occurred when application of a stretch was continued after heating. This is due to a reorganization of tissues during the cooling process. This long-lasting or plastic elongation is due to a separation of adjacent collagen fiber attachments within the connective tissue meshwork.

The availability of methods to increase the extensibility of these tissues should make ROM and stretching exercises more effective in improving the mobility of affected joints. However, according to Lehmann, further information is needed to identify the most effective method applicable. We believe our results have provided some of that information.

From this experiment, we have learned the rate of temperature decay following 3 MHz ultrasound treatments. From these data, we have determined the time frame for which heat and stretch therapy will be the most effective, and have labeled this the “stretching window.”

Vigorous heating is considered a raise in the temperature >3°C above baseline temperature. It is not feasible to put an exact time on temperature decay that will apply to all people and all situations. However, we have come up with what appears to be an accurate average time period to use with 3 MHz ultrasound.

In our study, the temperature was raised 5°C. If, for example, a clinician performed ultrasound that raised the temperature 5°C, and then applied a stretch, the critical “stretching window” would last, on average, only 3.3 minutes after the termination of the ultrasound application. If the temperature were only raised 4°C,
the stretching window would be open less than 2 minutes. This time period can be increased by applying the stretch during the ultrasound treatment.

The Table shows the rate of heating during ultrasound treatments. By using this table, one can estimate how long it takes muscle to reach a chosen temperature during 3 MHz continuous ultrasound. If, for example, the clinician applied ultrasound at 1.5 W/cm², on average, an increase of 5°C would take 5.5 minutes. However, at this intensity, an increase of 3°C would take place at 3.3 minutes into the treatment. If the clinician applied a stretch at this point and held it until the tissue temperature reached 5°C over baseline, the stretching window would have increased over 2 minutes in length. Therefore, when the tissue temperature is raised 5°C, the stretching window lasts an average of 3.3 minutes using the heat-then-stretch technique, and 5.5 minutes using the stretching-and-cooling technique.

It is important to point out that we studied 3 MHz temperature decay, instead of the more popular 1 MHz frequency. Our reason for this is that the 3-MHz frequency is absorbed superficially and is ideal for treating structures that lie within 1 to 2 cm deep. Many adhesive conditions lie <2 cm below the skin’s surface. The 1-MHz frequency is used for treating areas up to 5 cm below the skin. The possibility exists that temperature decay might be slower following 1 MHz ultrasound since the deeper muscle temperature is higher to begin with, and the additional tissue thickness may serve as a barrier to cooling. A further investigation could replicate our study, but measure temperature decay of 1 MHz ultrasound. This might reveal the stretching window for treating deeper conditions, such as piriformis syndrome.

Another point to consider is that our data were obtained from temperatures recorded in muscle; therefore, our stretching window may not apply to less vascular structures. Not all connective tissues are alike, and the possibility exists that their heating and cooling rates may vary. For example, it is believed that tendon, since it is a dense substance, will heat faster than muscle. Because it is less vascular than muscle, the possibility exists that tendon may cool at a slower rate than muscle, but this has not yet been tested in humans. Future researchers could test the rate of temperature decay in human tendon, to see whether it differs from muscle and similar connective tissue. However, since muscle is less dense than tendon, it may yield more to heat and stretch. Therefore, we feel that if the ultrasound unit is applied to the musculotendinous junction, our stretching window has merit.

Past research has shown that ultrasound is effective in heating collagenous tissue. We have uncovered a treatment window regarding stretching of superficial connective tissue structures (<2 cm deep) following ultrasound therapy. This can serve as a guideline for when optimal stretching should occur following ultrasound. This will enable clinicians to effectively increase joint ROM for adhesive capsulitis, tendinitis, and joint contractures.

We feel that our research has revealed an effective technique for ultrasound use when increased extensibility of collagen tissue is desired.

ACKNOWLEDGMENTS

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Acute Exertional Rhabdomyolysis and Its Relationship to Sickle Cell Trait

Gary L. Harrelson, EdD, ATC; A. Louise Fincher, EdD, ATC; James B. Robinson, MD

ABSTRACT: Exertional rhabdomyolysis, a syndrome characterized by skeletal muscle degeneration and muscle enzyme leakage, has been shown to occur in normal, healthy individuals following strenuous exercise. In severe cases, this syndrome can result in renal failure and sudden death. Although anyone who performs strenuous exercise may be at risk for developing exertional rhabdomyolysis, some individuals may be more susceptible than others. A number of case reports of exertional rhabdomyolysis involve persons with sickle-cell trait, leading to the theory that these individuals might be at greater risk for developing the syndrome than those without this trait. This article discusses the etiology of exertional rhabdomyolysis, the associated risk factors for persons with sickle-cell trait, and the recommended preventive measures. Additionally, several case studies of exertional rhabdomyolysis are reviewed.

S{} strenuous exercise has been shown to result in leakage of myoglobin and cellular enzymes from skeletal muscle in normal, healthy individuals. In fact, the occurrence of this leakage has been documented in athletes from a variety of sports, including cross-country skiing, marathon running, rowing, soccer, and weight training. However, enzyme leakage resulting from strenuous exercise has also been associated with the potentially life-threatening syndrome known as exertional rhabdomyolysis. In clinical cases of rhabdomyolysis, this release of myoglobin initiates a cycle of metabolic complications, which in severe cases has led to renal failure and death.

Anyone who performs extremely vigorous exercise is at risk for developing this syndrome; poorly conditioned individuals who perform strenuous exercise may be more predisposed. Additionally, numerous case reports of exertional rhabdomyolysis have involved persons with sickle-cell trait, leading to the theory that persons with sickle-cell trait might be at greater risk. This article discusses the etiology of exertional rhabdomyolysis and the associated risk factors for persons with sickle-cell trait. Additionally, we will review reported cases and discuss the implications of this syndrome for athletic trainers.

BACKGROUND

The incidence of exertional rhabdomyolysis has been most widely reported and studied in military recruits. The greater occurrence of the syndrome in this population is thought to be due to the extreme physical exertion required during basic training. As early as 1967, eight cases of exertional rhabdomyolysis and acute renal failure were reported in military recruits. This syndrome gained more attention in 1971, however, when 40 men from a single Marine platoon were hospitalized with symptoms. The increased awareness led to an increase in research efforts to identify the etiology.

Research shows that if muscle cells are damaged due to extreme physical exertion, they release myoglobin and other cellular enzymes into the blood. As blood levels of myoglobin (myoglobinemia) increase, myoglobin eventually spills over into the urine (myoglobinuria) causing the urine to darken in color. Although most cases of rhabdomyolysis result in some degree of myoglobinuria, about 5% to 7% of these cases progress to renal failure. The exact mechanism for this renal failure is unknown. Milne, however, proposes that it is due to renal tubule damage.

In vitro studies show that myoglobin breaks down to globin and ferriheamate with the latter of these two being toxic to renal tubule epithelium. As the renal tubules become damaged, fluid transportation is impaired. This leads to decreased urine excretion and eventual renal failure. Dehydration and/or metabolic acidosis can increase the chance of renal failure. As exertional rhabdomyolysis progresses, a cascade of electrolyte and enzyme imbalances occur (Table 1). Some of these changes in the blood chemistry have the potential to trigger life-threatening complications. For example, increases in potassium can lead to skeletal muscle weakness as well as abnormal heart contractions and possible cardiac arrest. Similarly, decreased in calcium levels can cause skeletal muscle tremor or tetany and decreased excitability of heart muscle.

Reported cases of exertional rhabdomyolysis follow one of two scenarios: sudden collapse accompanied by acute renal failure or the gradual onset of muscle soreness and renal dysfunction. General signs and symptoms are outlined in Table 2. Severe cases involve sudden collapse, and these symptoms may not be apparent to the athletic trainer. Therefore, the possibility of exertional rhabdomyolysis should be considered in all athletes, especially those with sickle-cell trait who collapse suddenly after strenuous exercise. With milder cases of exertional rhabdomyolysis, the symptoms are often overlooked initially, since some degree of muscle soreness and
fatigue are expected when beginning a training program or after an excessively strenuous workout. The presence of dark-colored urine is often dismissed initially and thought to be simply the result of increased concentration due to fluid lost through perspiration. Hematuria (gross and/or microscopic blood in the urine) has also been reported to occur in runners due to the repetitive impact forces of footstrike causing damage to red blood cells (hemolysis) or trauma to the bladder.

Hematuria, however, is not serious and is usually self-resolving. Myoglobinuria, on the other hand, as described previously, is not self-resolving and, instead, is capable of causing renal failure. Therefore, if darkened urine is reported, particularly when reported in combination with muscle pain or cramping, a physician should be consulted immediately to rule out myoglobinuria and the possibility of exertional rhabdomyolysis.

SICKLE CELL TRAIT AND EXERTIONAL RHABDOMYOLYSIS

In the United States, estimates are that 7% to 9% of the African-American population have the sickle-cell trait. Although rare, sickle-cell trait has also been found in white American individuals who have had ancestral links to Africa, India, or the Mediterranean.

The sickle-cell trait is generally considered a benign condition and therefore should not preclude someone from participating in athletics. In 1973, Murphy studied the prevalence of sickle-cell trait in African-American professional football players. Blood samples were taken from all but nine of the African-American players (n = 579) with 20 of the 26 NFL teams participating in the study. Test results revealed that 39 of these athletes carried the sickle-cell trait. Discussion with the team physicians of these athletes revealed no previous incidence or problem. Therefore, Murphy concluded that sickle-cell trait did not limit the physical capabilities of these athletes. Similarly, Diggs and Flowers screened 142 black high school football and basketball athletes for sickle-cell trait and found 15 athletes (10.5%) who carried this trait. Over a 2-year period, these 15 athletes participated in training programs and two competitive seasons without any evidence of disability or problems. The percentage of sickle-cell trait in these athletic populations was equivalent to that of the general population. Several studies have also shown no difference in the exercise capacity of persons with sickle-cell trait when compared to persons without this trait.

Despite this research, the fact remains that sickle-cell trait has been associated with episodes of sudden collapse during or immediately after exercise in 30 reported cases with 20 of these cases resulting in death. At least 17 of the total reported cases of sudden collapse and/or death in persons with sickle-cell trait have specifically involved exertional rhabdomyolysis. Karki retrospectively studied all (n = 62) reported deaths among recruits in basic training from 1977 to 1981 and found that recruits with sickle-cell trait were at a 28 to 40 times greater risk for sudden unexplained exercise-induced death. These sudden unexplained exercise-induced deaths could be related to acute cardiac arrest of undefined mechanism, exertional heat stroke, heat stress, or rhabdomyolysis.

It is not fully understood whether sickle-cell trait itself or some other unidentified but associated metabolic defect makes a small subgroup of patients with sickle-cell trait more susceptible to the development of exertional rhabdomyolysis. Sher stated that strenuous exercise alone likely does not precipitate the cascade of events leading to exertional rhabdomyolysis in persons with sickle-cell trait. He proposed that dehydration might contribute to the development of sickling in muscle capillaries. As cited by Sherry, Cochran theorized that persons with sickle-cell trait might be naturally more predisposed to dehydration due to their inability to concentrate their urine when deprived of water. This defect might make persons with sickle-cell trait less able to conserve water than persons without this trait. Athletes with sickle-cell trait may require a larger water intake in order to maintain proper fluid balance than those without the trait. This renal concentrating defect in persons with sickle-cell trait could easily exacerbate a state of dehydration caused by viral infection, caffeine or other drug consumption, or excessive perspiration. The primary risk factors for exertional rhabdomyolysis in persons with sickle-cell trait include: 1) extreme heat and humidity, 2) high altitude, 3) exercise-induced asthma, and 4) pre-event fatigue due to illness or lack of sleep.

REVIEW OF SELECT CASE REPORTS

In 1972, a 22-year-old African-American military recruit with sickle-cell trait suddenly collapsed after running 3 miles. Within 4 hours after exercise, he complained of muscle tenderness over the abdomen, back, and extremities. The recruit had experienced diarrhea 2 days before his collapse; however, he had not reported this to medical personnel. Despite immediate treatment for acute renal failure and exertional rhabdomyolysis, the subject died 48 hours later.

Similarly, Koppes described four Air Force recruits with sickle-cell trait who developed exertional rhabdomyolysis.
while undergoing training. Three out of the four collapsed suddenly. Two out of the four were described as athletic and had been exercising strenuously for several months; the other two were in good health and had been training for more than 4 weeks. All of the subjects complained of severe muscle cramps and swelling and were diagnosed with exertional rhabdomyolysis associated with acute renal failure. One of the subjects died; the other three survived and recovered normally.

In 1985, two other exercise-related deaths were reported in African-American military recruits with sickle-cell trait. Both cases involved sudden collapse after running, the development of exertional rhabdomyolysis with renal failure, and death within 36 hours of the collapse. In 1990, Sherry reported a 17-year-old Air Force cadet with sickle-cell trait who developed exertional rhabdomyolysis and renal failure after performing strenuous calisthenics and a 1.5 mile run. This cadet had been running up to 5 miles a day without difficulty. One week before his collapse, however, he had suffered a viral infection with nausea and vomiting. After regaining consciousness, the cadet complained of severe leg cramps. This cadet eventually recovered.

There have also been several reported cases of exertional rhabdomyolysis involving athletes or recreationally active persons with sickle-cell trait. Helzlsouer et al described an African-American cross-country runner with sickle-cell trait who collapsed suddenly on two separate occasions. After the first incident, the athlete vomited and complained of shortness of breath, abdominal pain, nausea, and leg cramps. He also reported that he had taken a decongestant the evening before his collapse. Although he recovered without complications, he was advised to discontinue competitive running. He continued to run, however, until his second collapse a year later. With the second episode, he required mouth-to-mouth resuscitation and immediate transport to the local emergency room where he was diagnosed with rhabdomyolysis and renal insufficiency. After regaining consciousness, he was disoriented and complained of severe leg cramps. The athlete was discharged from the hospital 1 month later, although he still showed signs of mild renal insufficiency. This athlete no longer runs competitively.

In 1991, a 22-year-old football player suddenly collapsed after completing an 800 m run. This athlete had been training intensively for several weeks and had just passed a preparticipation physical examination. Despite aggressive and immediate treatment for exertional rhabdomyolysis, the patient died 46 hours after his collapse. Autopsy results revealed that the athlete had sickle-cell trait.

Browne and Gillespie reported a case of exertional rhabdomyolysis in a 20-year-old African-American football player with sickle-cell trait. The athlete developed bilateral pain in his lower back, hamstrings, and calves after completing a timed 1-1/2-mile run on the first day of practice. Although the athlete had conditioned over the summer, he had primarily run sprints rather than long distances. The athlete was diagnosed with rhabdomyolysis and exercise-induced asthma and was hospitalized for 4 days. When the athlete’s blood chemistries were normal (with the exception of creatine kinase levels, which remained elevated), he was allowed to return to supervised conditioning activities and within 2 weeks returned to full practice with the exception of distance runs. This athlete was “aggressively hydrated” before, during, and after all activity. Due to his exercise-induced asthma, supplemental oxygen was administered during all games. This athlete finished the season without any other episodes of exertional rhabdomyolysis. However, weekly blood tests demonstrated elevated creatine kinase levels throughout the season.

**DISCUSSION**

Although exertional rhabdomyolysis has not been as widely reported in the athletic population as in the military population, there appears to be a growing number of case reports documenting this syndrome in athletes and/or recreationally active people. For this reason, exertional rhabdomyolysis and its potentially life-threatening sequelae have serious implications for the athletic trainer.

On a daily basis, athletic trainers deal with individuals who perform strenuous exercise. Many of these individuals are at risk for developing exertional rhabdomyolysis due to their sickle-cell trait status, poor level of conditioning, or geographic location (especially hot, humid climates or elevated altitudes). The successful management of this life-threatening syndrome requires early recognition and prompt referral to the nearest emergency room for immediate treatment.

Browne and Gillespie credited their athlete’s recovery and return to activity to the fact that both the team physician and athletic training staff were aware of this young man’s sickle-cell trait status. This prior knowledge enabled the athletic trainers to quickly recognize the development of this syndrome and therefore seek prompt medical attention. As a result, they recommend that professional and collegiate athletic institutions implement standard sickle-cell trait testing for all athletes at risk, particularly for those athletes whose sports require extreme exertion in either hot, humid climates or locations of high altitude.

Identification of persons with sickle-cell trait, through program-wide testing procedures, could enable athletic trainers, under the direction of their team physician, to implement guidelines for preventing exertional rhabdomyolysis. However, program-wide sickle-cell trait testing is considered controversial by some and unnecessary by others. The cost-effectiveness of such a program has also been questioned since the average cost per sickle-cell trait blood test ranges from $10 to $15. Depending upon an athletic program’s size (number of athletes) and budget, this figure could possibly be cost-prohibitive. As suggested by Browne and Gillespie, knowledge of an athlete’s sickle-cell trait status can provide an added sense of security when implementing a preventive program for exertional rhabdomyolysis. Additionally, knowledge of an athlete’s sickle-cell trait status can facilitate early recognition of this syndrome allowing for prompt treatment and/or referral. Table 3 outlines the recommended measures for preventing exertional rhabdomyolysis in athletes with sickle-cell trait.

Many of these measures should be included in any injury/illness prevention plan regardless of sickle-cell trait status. Athletic trainers who are able to recognize this syndrome and seek prompt medical attention can greatly improve the
Table 3. Recommended Measures for Preventing Exertional Rhabdomyolysis in Athletes With Sickle-Cell Trait

1. Implement a conditioning program prior to athlete’s return to sport activity each season.
2. Modify conditioning exercises, as necessary, during the athletic season.
3. Implement aggressive hydration policies before, during, and after all activity.
4. Educate athletes regarding the dangers of beverages containing caffeine, i.e., their diuretic effect.
5. Avoid strenuous exercise in extremely hot and humid conditions.
6. Avoid strenuous exercise at altitudes above 2500 ft.
7. Modify activities after any viral illness, particularly illnesses involving diarrhea or vomiting.
8. Modify activities after nights of poor sleep.

Outcome for athletes suffering from exertional rhabdomyolysis. It was not our intent to promote or oppose program-wide sickle-cell trait testing. Further investigation is warranted to determine the number of professional and collegiate athletic programs currently testing for sickle-cell trait and the implications of such testing procedures.

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A Disordered Eating Response Team’s Effect on Nutrition Practices in College Athletes

Janine T. Baer, PhD, RD, LD; William F. Walker, MA, ATC; Jayd M. Grossman, MEd, ATC

ABSTRACT: The disordered eating response team developed a protocol for assessment and intervention for athletes who are identified as at risk for disordered eating. Team members included the team physician, athletic trainers, a dietitian with knowledge of sports nutrition, and a psychologist. Team members also developed education programs for coaches and athletic trainers, athletes, and dining services personnel regarding eating to support health and athletic performance. During the first year of the program, 12 athletes were referred to the disordered eating program. Evaluations from the education programs indicated that they were well received by all participants. Information considered to be most useful by the athletes included: high-carbohydrate vs high-fat foods (98%), timing of food intake (88%), and fluid needs (68%). Topics about which the athletes requested more information included: increasing lean body mass (70%) and foods to eat while traveling (65%). In response to the program(s), the athletes reported increased intake of carbohydrate foods (100%), decreasing intake of caffeine-containing beverages (68%), and increasing dietary intake of iron and calcium (78% females). Our programs have improved athletes’ knowledge of nutrition to support health and performance and have provided intervention for athletes at risk for disordered eating.

The National Collegiate Athletic Association (NCAA) has always supported intervention and prevention of eating disorders in college athletes. In 1988, they released a three-part videotape series on eating disorders to educate athletic administrators, coaches, athletic trainers, and athletes regarding these serious conditions. Their previous call to attention and action regarding eating disorders was recently heightened following the death of Christy Henrich, a member of the 1989 world gymnastics team who died July 26, 1994, after a long battle with anorexia and bulimia.

The American College of Sports Medicine (ACSM) has also put out a call to action regarding education and intervention for female athletes who may be at risk for eating disorders. “The female athlete triad: disordered eating, amenorrhea and osteoporosis,” is a phrase coined by the ACSM to describe the three interrelated problems observed in female athletes that can cause long-term health problems for the athlete.2

The prevalence of disordered eating in female athletes has been reported by Rosen to be as high as 62%.1,8 Disordered eating differs from the defined clinical eating disorders, anorexia nervosa and bulimia nervosa. Rather, it refers to those who exhibit less severe or subclinical forms of eating disorders that meet some but not all of the formal diagnostic criteria of anorexia nervosa, bulimia nervosa, and eating disorders not otherwise specified.3,4,6,9,10 Disordered eating can thus be thought of as a continuum of undesirable eating patterns ranging from poor nutrition to subclinical forms of eating disorders, to behaviors and eating patterns associated with clinical eating disorders.3,5 All points along the continuum can have serious consequences for the athlete’s health and, left untreated, may be the beginning of what leads to overt anorexia nervosa or bulimia nervosa.5

THE DISORDERED EATING RESPONSE TEAM PROGRAM

In response to the recommendations by the NCAA and ACSM, the Disordered Eating Response Team was initiated by the head athletic trainer and the team physician at The University of Cincinnati to support the health and athletic performance of all athletes, with special reference to those identified as disordered eating. Members of the team include the team physician, head athletic trainer, staff athletic trainer (only one athletic trainer participates, to promote continuity and facilitate communication), a dietitian knowledgeable about physical performance, and a psychologist. Their individual responsibilities are outlined in the Table.

If a coach, athletic trainer, or intercollegiate team member suspects a student athlete of demonstrating disordered eating behaviors, he or she is referred to the staff athletic trainer. The referral to the trainer is anonymous or the athlete can self-refer. The staff trainer meets with the athlete to discuss the concern(s) presented and explains that the athlete must be referred to the team physician. This referral is mandatory and must be completed as soon as possible. The trainer then notifies the disordered eating team members that a referral had been made. The team physician conducts an examination, and, following a diagnosis of disordered eating (including anorexia nervosa and bulimia nervosa), explains to the athlete that he or she will be referred to the dietitian and psychologist as part of the team treatment plan. If disordered eating is not diagnosed, the student athlete may still be referred to the dietitian and/or...
Responsibilities of the Disordered Eating Response Team Members

| Team Physician: | Assesses and monitors medical status of the student athlete. |
| Diagnoses disordered eating and refers athlete to team members. |
| Makes decision regarding participation. |
| Athletic Trainer (Head): | Acts as liaison between team members and administrative personnel. |
| Acts as liaison between student athlete(s) and administrative personnel. |
| Athletic Trainer (Staff): | Coordinates disordered eating response team procedures and acts as liaison between team members. |
| Acts as liaison between student athlete and team members. |
| Monitors daily status of student athlete. |
| Ensures compliance with team recommendations. |
| Dietitian: | Monitors nutritional status and eating patterns of student athlete. |
| Educates student athlete regarding energy and nutrient adequacy to support health and performance. |
| Identifies problems in eating patterns and helps develop strategies to normalize eating patterns. |
| Psychologist: | Conducts psychotherapy assessment and develops treatment plan. |
| Addresses related underlying psychotherapy issues related to weight and body issues that are driving the athlete to be thin. |

The team meets monthly, or sooner if deemed necessary, to discuss new cases as well as continue to evaluate current cases and make modifications in treatment.

EDUCATION PROGRAMS

Concurrent with the inception of the program for disordered eating, preventive measures for all athletes were developed to increase their awareness of appropriate nutrition to support health and physical performance and to decrease the incidence and severity of disordered eating among athletes. The preventive measures included separate educational sessions for coaches (including coaches for teams not specifically categorized as sports by the NCAA, cheerleading and dance) and trainers, athletes, and dining services personnel.

At the session for coaches and trainers, the dietitian explained the role of food in supporting health and athletic performance and dispelled erroneous beliefs regarding relationships among body composition, performance, and food intake. For example, endurance athletes often believe that the lower their body fat, the better they will perform. Also, athletes may be instructed to consume no more dietary fat than their desired body fat composition (eg, if athletes want to maintain a 9% body fat composition, they can consume no more than 9% of their total daily caloric intake from fat). Both of these thoughts are incorrect.

The psychologist increased the coach's awareness of the heightened level of dissatisfaction athletes feel regarding their bodies. She suggested subtle comments and innuendos that coaches or peers could be using to influence disordered eating behaviors. The psychologist also identified behaviors that may warrant referral.

The dietitian presented separate seminars on "Nutrition to Support Athletic Performance" to athletes. The seminars were organized by sport, including women's basketball, football, men's and women's volleyball, men's and women's soccer, men's and women's track and cross-country, and men's and women's swim team. Men's basketball was not included as they had previously established intervention on an individual,
as needed, basis. Women’s gymnastics and wrestling were not included as they are not offered as intercollegiate sports at this institution. Gymnastics and wrestling would be important to include, as they are high-risk sports for disordered eating. Cheerleaders and dance team members were included as they are considered to be at high risk for disordered eating practices. The purpose of the presentation was to ensure that all athletes become aware of how nutrition supports health and athletic performance. While similar in overall content, the seminars were tailored to meet specific audiences’ needs (the importance of calcium, iron, and zinc was highlighted to the women). At the time of the seminar, the athletes were informed of the disordered eating program, its goals, and members. Also, the athletes were told that if they wanted further individual dietary information/evaluation, they could receive such a service with a referral from their coach to the head athletic trainer.

The dietitian and head athletic trainer met regularly with the head of dining services to discuss menu schedules and food menu items offered at the dining halls to ensure that athletes were able to make food choices compatible with dietary recommendations to support athletic performance. Additionally, the dietitian, head athletic trainer, coaches, and dining services personnel would meet to discuss menus for training camps and pre-event/post-event meals during the competitive season while at home and away.

EVALUATION OF PROGRAMS

During the first year of the programs at our institution, identification, assessment, and intervention of disordered eating athletes increased from 1 to 12. Evaluations from the education programs (56% response rate) indicated that 100% of those attending liked the format. The sessions were structured to include presentation of information, an activity to apply the information, and a question/answer session. Information considered to be most useful by the athletes included: how to identify high-carbohydrate vs high-fat foods (98%), timing of intake of food and/or fluid (88%), fluid needs and appropriate choices to rehydrate (68%). The athletes indicated they would like more information/guidance on techniques to increase lean body mass (70%) and further suggestions of how to maintain a high-carbohydrate diet while travelling or eating out (55%).

Dietary behaviors that were modified following nutrition education included increasing consumption of high carbohydrate foods (100%), increasing noncaffeinated fluids (68%), and increasing dietary intake of iron and calcium (78%) in females.

It is our experience that we have been able to develop and implement programs to support both intervention and prevention strategies to decrease disordered eating among athletes. We have also been able to improve knowledge of nutrition among athletes to support their health and performance.

Our follow-up plans include continuing with the protocol for disordered eating intervention. Additionally, we are developing a nutrition curriculum to be implemented to all athletes annually to reinforce the role of nutrition in supporting health and performance. We believe that programs similar to ours could be implemented at schools as long as there is support from administrative personnel.

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A Comparison of Isokinetic and Isotonic Predictions of a Functional Task

Mitchell L. Cordova, MA, ATC; Christopher D. Ingersoll, PhD, ATC; John E. Kovaleski, PhD, ATC; Kenneth L. Knight, PhD, ATC

ABSTRACT: Controversy still exists regarding the use of isokinetic and isotonic exercise in rehabilitation. Many authors have compared these two types of training methods on various strength measures and functional activity, but have used open kinetic chain training. The purposes of this investigation were to determine: 1) which form of closed kinetic chain training, isokinetic or isotonic, would produce the greatest increase in one-legged jump reaction force, and 2) which training method most accurately predicts peak force produced during a one-legged jump. Forty-two legs from 21 female volunteer subjects were used. Each subject had her dominant and non-dominant extremities identified, and then each extremity was randomly assigned to either isokinetic training, isotonic training, or control. Both training groups trained using a leg press exercise 3 days a week for 5 weeks, while the control extremities did not train. The isokinetic extremities were trained using a velocity spectrum (two sets of 10 repetitions at each speed: 60°, 180° and 240°/sec) and the isotonic extremities trained using the DAPRE technique. Data were analyzed with an analysis of variance (ANOVA). There was no difference between the three groups for change in one-legged jump force. Both isokinetic and isotonic groups increased strength after training, but these changes did not correlate with changes in one-legged jump reaction force. These results suggest that changes in neither isokinetic force nor isotonic weight lifted developed in a non-weight-bearing closed kinetic chain, directly translate into increased force production during a functional activity.

Isokinetic and isotonic exercise and testing procedures are often used in rehabilitation. Isokinetics are mainly used because of the ease of measuring muscle torque, power, and work under constant velocity. Several studies indicate that isokinetic exercise has more advantages than isotonic exercise when training muscle during rehabilitation. In contrast, isotonic training has been reported to be equal to or more effective than isokinetic training in which muscle contractions are similar to functional movement. Furthermore, isotonic exercise appears to be the most frequently used training method for injury prevention.

Functional rehabilitation of the injured limb is vital when preparing the athlete for return to competition following injury. Both isokinetic and isotonic strengthening exercises are used extensively for this purpose. There is some debate as to whether isokinetic or isotonic devices are more beneficial in producing functional strength gains. Studies reporting the conflict between training methods fail to identify whether the measurements reflect an estimate of functional strength. It has not been established whether isotonic or isokinetic training is valid when assessing estimates of functional strength. The purposes of this study were to determine: 1) which method of closed kinetic chain training, isokinetic or isotonic, would produce the greatest increase in peak one-legged jump reaction force; and 2) which training method most accurately predicts changes in peak force produced during a one-legged jump.

Mitch Cordova was a graduate student in the Athletic Training Department at the time of the study. He is currently a doctoral student in biomechanics at The University of Toledo. Christopher D. Ingersoll is an associate professor; John Kovaleski is an assistant professor; and Kenneth L. Knight is a professor and chairperson. All are associated with the Athletic Training Department of Indiana State University in Terre Haute, IN.

METHODS

A 2 X 3 factorial design was used, with lower extremity (dominant/nondominant) as one independent variable and the type of training (isokinetic, isotonic, or control) as the second independent variable. The dependent variables were percentage change in one-legged jump reaction force, percentage change in average peak isokinetic force produced at 60°/sec, and percentage change in isotonic weight lifted.

Forty-two legs from 21 university female volunteers (age = 21.5 ± 1.8 yr, ht = 160.7 ± 4.5 cm, wt = 60.2 ± 9.3 kg) were used in this study. Individuals were screened to determine that none had sustained a significant lower extremity injury in the previous year, or had participated in any lower extremity strengthening or conditioning programs in the previous 6 months. Before participation in the study, subjects completed an informed consent statement and health questionnaire. This study was approved by the University Institutional Review Board.

To determine which leg was dominant and which one was nondominant, we used the “kick the ball” test. Training or control protocols were randomly assigned to the dominant and nondominant leg of each subject, thus each leg for each subject could either train isokinetically, isotonically, or not train (control).

Before testing began, each subject participated in an orientation session in which they performed multiple repetitions of the training and test protocols until proper technique was achieved. This was done to minimize learning effects during testing. Pretesting occurred over 2 days. One-legged jump reaction force was measured on one day, and average peak isokinetic force or weight lifted during the isotonic leg press was measured the following day.

One-legged vertical jumps were performed on a Kistler Piezoelectric force platform. Ground reaction forces were recorded and interfaced through an analog-to-digital converter board positioned...
in a 486 microcomputer. The Ariel Performance Analysis System software was used to determine vertical ground reaction force. Subjects performed the one-legged jump test with both legs before the 5-week training period. The dominant leg was tested first, followed by the nondominant leg. Each leg performed eight one-legged jumps and an average peak force of the eight trials was used as the estimate of functional strength. The one-legged jump was performed without arm movement.

The isokinetic-trained legs were tested before the 5 weeks of training for peak force at 60°/sec while performing a leg press on the Kin-Corn II isokinetic dynamometer. The average peak isokinetic force for three trials was used for the pretest strength measure. The fourth set working weight of the daily adjustable progressive resistance exercise (DAPRE) technique was used for the pretest strength measure for isotonically trained legs.

After pretesting was completed, legs assigned to isokinetic and isotonic training were exercised 3 days per week for 5 weeks. Significant strength increases have been reported with isotonic and isokinetic training protocols of short duration. During the training period, subjects were asked to refrain from additional lower extremity strengthening or conditioning. Each training session was supervised by the principal investigator to ensure that the standardized training protocol was followed. Legs assigned to isokinetic training were exercised first.

The isokinetic legs were trained on the Kin-Corn II which was set up to perform a leg press exercise (Fig 1) as previously reported. Each subject exercised the assigned leg using a velocity spectrum training protocol. Two sets of 10 repetitions at 60°, 180°, and 240°/sec were performed. This protocol was designed to stimulate motor units from both type I and type II fibers by exercising at low and high velocities. Strength increases have been reported using a similar protocol.

The isotonic legs were trained on the Norsk leg press machine using the DAPRE technique. The DAPRE technique involves performing four sets of repetitions. During the last two sets of the exercise session, subjects perform as many repetitions as possible and the working weight for the subsequent set or day is adjusted appropriately. The legs assigned to control did not train.

Subjects were tested after 5 weeks of training using the same procedures and measurements used for pretesting. Two methods were used to assess strength gains: 1) percentage change ((post-test–pretest/pretest) × 100) in peak one-legged jump reaction force was used to estimate functional strength gains resulting from training; and 2) percentage change in average peak force was calculated to determine isokinetic strength gains after isokinetic training, while the percentage change in the fourth set working weight of the DAPRE technique was used to represent change in strength for the isotonic-trained extremities.

A two-way analysis of variance (ANOVA) was used to determine if differences existed across extremity (dominant/nondominant) and training (isokinetic, isotonic, and control) in relation to change in peak one-legged jump reaction force. A linear regression equation was computed for both isokinetic and isotonic strength change for one-legged jump reaction force. The corresponding coefficients of determination (R²) for isokinetic and isotonic regression equations were compared using an F-ratio. Independent t-tests were computed for both isokinetic and isotonic groups to determine strength differences after training. The p < .05 level of significance was used for all tests.

RESULTS

Five weeks of training resulted in strength changes of 50% and 64%, respectively, in the isokinetic (t(24) = 5.8, p < .05) and isotonic (t(26) = 9.5, p < .05) training groups. However, neither extremity (F(1,36) = .11, p = .74) nor training group increased peak one-legged jump reaction force (F(2,36) = .27, p = .76; see Table). Changes in isokinetic and isotonic strength did not correlate with changes in one-legged jump reaction force (r = .134, p = .09), than did the isokinetic strength change (F(1,11) = .201, p = .66) in predicting one-legged jump reaction force. Because the statistical power in the study was not optimal (1–β = .54), there was a possibility that true differences existed, but were not detected.

DISCUSSION

Previous studies have not compared isokinetic leg press dynamometry training to an isotonic leg press training protocol for increases in vertical jump force. Some authors, however, did compare isokinetic training to isotonic training for effects on vertical jump height. Helling reported an 18.2% increase in vertical jump height following isokinetic training, and only an 11.7% increase following isotonic training. The isotonic group in this study appeared to have a distinct advantage over the isotonic group possibly due to specificity of exercise and similar mechanics between the Leaper leg press machine and performing a two-legged vertical jump. Also, the muscles trained were different. In another study, two-legged vertical jump height increased 5.4% following high velocity isokinetic and 3.9% following low velocity isokinetic training while an isotonic group experienced a somewhat smaller increase (1.6%) in vertical jump height. The isotonic training protocol in this study seemed to be less demanding, as the isokinetic group performed many more repetitions to 50% fatigue.
The trend in our study was that isokinetically trained and control extremities produced greater gains in one-legged jump reaction force than did the isotonically trained extremities. Other researchers have reported greater gains in vertical jump height after high velocity isokinetic training as well. Training at high velocities apparently stimulates type II muscle fibers and increases the muscle's ability to produce power. Specificity of velocity in training is important during ballistic contractions when exclusive activation of high threshold motor units may occur.12

As a result, isokinetic training at 180° and 240°/sec could help account for the small change in force production observed from the leg extensor musculature during the one-legged jump. Other studies have demonstrated a high correlation between high velocity isokinetic torque production and vertical jump height measured from a force platform. A direct relationship exists between vertical jump height and maximum jump force. Subjects whose extremities trained isotonically were instructed to perform the contraction to a deliberate controlled cadence, where the concentric and eccentric phases were completed in 2 and 3 seconds, respectively. With velocity not being a factor during the contraction, the type IIb fibers and power component of the muscles may not have been greatly stimulated. Furthermore, the DAPRE technique has been shown to increase strength, but not muscular power as determined by the Sargent vertical jump test and Lewis formula. The mean strength gain of 64% achieved by the isotonic group using the DAPRE technique was similar to a previously reported study comparing both training methods. Other authors reported large strength increases (81% and 164%) using the DAPRE program with female subjects. However, these previous studies used a knee extension and not a leg press exercise.

It is difficult to ascertain why subjects gained strength with each respective training program but did not show increases in one-legged jump reaction force. We hypothesized that strength (isokinetic or isotonic) increases produced in a nonweight-bearing closed kinetic chain movement do not correlate to muscle force production during weight-bearing closed kinetic chain activity. Perhaps this theory can be explained best by neural factors such as specificity of strength training and/or co-contraction by the antagonists.

Thorstenssen et al reported that 8 weeks of barbell squat training resulted in an increase in weight lifting strength and isometric leg press strength, but not in isometric knee extension strength pre- to posttraining. I-EMG was recorded pre- and posttraining for isometric knee extension. No change occurred suggesting specificity of movement pattern and contraction type in strength training.

Hamstring co-contraction is greater during a weight-bearing activity than during a nonweight-bearing activity in a closed kinetic chain. This could help explain why there were no increases in force production by the leg extensors because co-contraction of the antagonists may provide stabilization during rapid and precise agonist contractions, and in doing so act as a breaking mechanism in ballistic contractions such as jumping. However, Brask et al reported that hamstring involvement during a weight-bearing activity may not be very substantial; an 8-inch lateral step-up protocol produced only 9.4% and 8.9% of maximal voluntary contraction from the biceps femoris and semimembranosus/semitendinosus muscles.

Other possible explanations for the lack of correlation between strength gains produced in a nonweight-bearing closed chain activity and strength gains in a weight-bearing activity may come from motor control and balance mechanisms. Because the subjects in this study were untrained, it is possible that a certain level of skill was not present while performing the one-legged jump, in turn contributing to no change in the jump force.

The one-legged jump is also an activity that requires the ability to balance. In performing a leg press activity, balance is not essential to executing the activity. Each subject performed eight jumps for each leg during each test which, may have caused the lower leg musculature to fatigue. Lundin et al reported that as ankle plantar and dorsi flexors fatigued, postural sway during a one-legged stance increased. Balance may have been disrupted, contributing to insignificant force production. Although balance was not measured during this
study, it may be an important neural component to train when considering one-legged jump performance.9

Even though isokinetic and isotonic strength gains did not significantly correlate with one-legged jump reaction force, the isotonic group did demonstrate a stronger relationship. The relationship that existed was inverse in nature, suggesting that as isotonic strength increased, one-legged jump reaction force decreased. A possible explanation for this inverse relationship may be that the subjects’ focus was to produce greater force during training while ignoring the balance and other motor control aspects of the jumping movement. Additional research needs to explore the mechanism for this inverse relationship between estimates of isotonic leg press strength and one-legged jump reaction force.

CONCLUSIONS

1. Strength changes occurring through a nonweight-bearing closed chain exercise do not necessarily increase strength in a weight-bearing closed chain activity.

2. Based on the results of this study, trainers should be cautious in assuming that each type of closed kinetic chain exercise results in specific functional strength improvement.

3. Performance of exercise rehabilitation needs to be very specific to the functional goals of the athlete.

4. Further research should evaluate different types of isokinetic and isotonic closed chain exercises for developing a valid closed kinetic chain assessment protocol.

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Liver Laceration in an Intercollegiate Football Player

Richard Ray, EdD, ATC; James E. Lemire, MD

ABSTRACT: Serious abdominal injuries in athletics, including liver trauma, are relatively rare. When they do occur, the athletic trainer and the team physician must be able to recognize the signs and symptoms and employ the appropriate first aid and follow-up care. In this paper, we present a case study of a football player who suffered a lacerated liver as a result of a forceful blow to the right side of the chest. Although his case was typical of most isolated liver injuries and he did not experience massive internal bleeding, the potential for life-threatening exsanguination exists and must be recognized by sports health care practitioners. Most isolated liver injuries can be treated nonsurgically. However, those patients with multiple organ trauma, deteriorating vital signs, or diminishing hemodynamic stability generally require immediate surgery. Athletes with persistent right upper quadrant pain, especially when accompanied by referred pain to the right shoulder, abdominal rigidity, guarding, or rebound pain should be considered to have a liver injury until ruled out by CT scan and liver enzyme studies. Our subject was typical of most athletic liver patients and he was able to resume light exercise after 5 weeks and full activity after 3 months.

The violent nature of contact and collision sports places high school, college, and professional athletes at risk for a variety of impact-related injuries. Although relatively rare, abdominal injuries are increasing in frequency, and now comprise 7% to 10% of all athletic injuries. The liver is involved in fewer than 5% of sports-induced abdominal injuries. Athletic trainers and team physicians must remain familiar with the signs, symptoms, and emergency procedures for the treatment of liver trauma, however, since this injury is one of a few in sports medicine that can be life-threatening. Indeed, because it is so rare, most athletic trainers are unlikely to be confronted by this injury more than once or twice during their careers. We present here a case of an intercollegiate athlete who suffered a lacerated liver under circumstances typical of normal play in football.

HISTORY

A 19-year-old white male football player in good health was struck forcefully over the right posterior chest wall by a tackler’s helmet while extending to catch a pass. He fell immediately to the ground in obvious pain. When we reached him, his diaphragm was in spasm and he was clutching the right side of his chest. He was conscious and alert. Several seconds after we arrived, he vomited once. After approximately 15 seconds, the diaphragm spasm subsided, but his breathing became rapid and shallow. Upper and lower extremity neurological exam was normal. The pulse was strong and steady. After the athlete began to calm, he was assisted to the sideline and examined in greater detail.

PHYSICAL EXAMINATION

Visual examination of the chest and abdomen was unremarkable. Palpation of the ribs revealed tenderness, but no deformity or crepitus, at levels 6 to 8 on the right side. The right upper quadrant of the abdomen was tender to palpation, the right upper quadrant of the abdomen and the athlete’s feet and legs were placed in an elevated position. After several minutes, it became clear that his pain and elevated respiration rate were not returning to normal, so he was transferred to the local hospital. Anterior-posterior radiographs of the chest were unremarkable for either rib fracture or pneumothorax. The CT with gastroenteric and intravenous contrast revealed a curvilinear tear coursing from the posteromedial margin of the posterior segment of the right hepatic lobe and extending anterolaterally, terminating approximately 3 cm from the right liver margin (Fig 1). No other visceral damage was identified. Hemoglobin was 15.5 g/dL; hematocrit was 40.8%. Packed cell volume was not obtained. All liver enzymes, except GAMMA GT (19 u/L), were elevated (SGPT [ALT] 186 u/L, SGOT [AST] 178 u/L, LDH 371 u/L). (NOTE: GAMMA GT, SGPT, and SGOT are liver repair enzymes. LDH is a tissue repair enzyme often associated with liver trauma.) One hour after injury, blood pressure was 136/72, pulse was 80, and respiration rate had stabilized at 12. The diagnosis was liver laceration with associated right-side rib contusion.

TREATMENT AND CLINICAL COURSE

The subject was admitted to the hospital and an IV with lactated Ringer’s was begun. A surgical consultation was obtained. Because the subject was hemodynamically stable, the decision was made to treat the injury nonsurgically. The patient remained in the hospital under close observation for 5 days. He

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was limited to intravenous fluids for the first 24 hours and resumed a normal diet thereafter. His chest and abdomen pain was controlled with IM Demerol for the first 4 days and Vicodin thereafter. IM Visteril was administered to control intermittent nausea. Hemoglobin level dipped to a low of 14.4, but rose to 16.5 at time of discharge. Liver enzymes remained slightly elevated, but were improving at time of discharge.

The patient was discharged on the fifth day postinjury and spent an additional week resting at home. He then returned to school and finished the semester without incident. Follow-up CT at 1 month demonstrated a significant improvement in the liver laceration (Fig 2). The athlete was withheld from football for the remaining month of the season. After 5 weeks, he was placed on a progressive cardiovascular exercise program that included stationary cycling and swimming, every other day, at 60% to 80% of maximum heart rate. He returned to running and weight training approximately 12 weeks postinjury. He was cleared to play football the following season and participated without incident.

DISCUSSION

Because of the risk of massive internal bleeding, injuries to the abdomen pose a potentially life-threatening scenario. Athletic trainers and team physicians who work with contact and collision-sport athletes, especially football, ice hockey, soccer, and lacrosse players, are exposed to mild abdominal trauma on a regular basis. Most of these injuries are minor and resolve spontaneously. Diaphragm spasm and mild abdominal wall and rib contusions are so common that more serious pathology is often initially overlooked. The fact that many internal injuries bleed slowly can contribute to the lack of suspicion for these conditions by athletic health care providers. Many cases of minor abdominal trauma leading to serious injury have been reported in the literature.

Spleen, kidney, and liver injuries account for the majority of sport-related abdominal injuries. Direct blows to the abdomen have also been reported to result in injury to the stomach, intestines, gall bladder, and diaphragm. Kidney injuries are commonly caused by blows to the flank and are recognizable because of flank pain and hematuria. Spleen injuries are second only to kidney injuries in athletics and are a potential source of catastrophic bleeding if not recognized immediately. Spleen injuries can result in subcapsular hematoma, simple contusion, or rupture. The bleeding can occur slowly, resulting in acute distress weeks after the injury. Most spleen injuries occur following a blow to the upper left quadrant of the abdomen. The athlete with active mononucleosis is at increased risk for spleen rupture due to the distension that can occur during this infection. Spleen trauma may result in referred pain in the left arm and shoulder (Kehr’s sign).

Most liver injuries are caused by a direct blow to the upper right quadrant of the abdomen. The possibility of a contracoup mechanism has been postulated, based on the experiences of some authors. The liver is often involved in multiple organ accidents that result in a significant increase in intra-abdominal pressure. Like most victims of liver injury, our subject suffered an injury to the right lobe. Right lobe injuries account for approximately 80% of all liver lacerations. This finding is thought to be due to the larger size of the right lobe and its juxtaposition to the ribs. Although the lacerated liver is certainly capable of massive bleeding, it often does not. There has been an increased trend toward nonoperative management of this injury. Surgeons have discovered that in approximately 70% of cases, the bleeding has stopped by the time the wound is explored in the operating room. Patients with deteriorating vital signs and unstable hemodynamics require immediate surgical intervention.

Differential diagnosis in this case included rib fracture, abdominal wall contusion, pneumothorax, rupture of the diaphragm, and hematoma or rupture of the stomach or other elements of the gastrointestinal system. The diagnostic tools of choice for detection of liver injury include CT scan and liver enzyme profile. Diagnostic peritoneal lavage and scintigraphy have also been used to detect liver injury. Although they are sensitive tests, they do not help the clinician establish the extent of the damage. Standard radiographs helped rule out rib fracture, pneumothorax, and diaphragm rupture in this case. Lack of blood in the vomitus, along with the presence of normal bowel sounds helped reduce GI trauma as a source of concern. Abdominal wall contusion, although potentially quite painful, usually result in discomfort only over the contusion.
often when the muscle is contracted,\(^7\) and do not present with rebound, guarding, or rigidity.\(^1^2\)

Our patient experienced an uneventful recovery from his injuries. Many complications to nonoperative management of liver trauma have been reported, however. Persistent bleeding, infected hematomata, hemobilia,\(^1^3\) subhepatic fluid collection, ruptured subcapsular hematomata, pneumonia, and bile leaks are among the most commonly reported complications.\(^1^5\) Although most complications occur within 10 days, some have been reported to occur up to 4 weeks postinjury. MacGillivray and Valentine\(^1^5\) have reported a case of pseudoaneurysm and arteriovenous fistula 56 days following liver injury.

CONCLUSION

Liver laceration is one of the most serious injuries an athlete can suffer. If these athletes remain hemodynamically stable and are able to successfully avoid postinjury complications, however, they can usually resume light exercise at about 4 weeks with return to sports between 3 and 6 months.\(^5^,\(^1^8\) Athletic trainers and team physicians should assume a high degree of suspicion when athletes under their supervision experience trauma to the abdomen. Even minor blows can have serious consequences, many of which may not be evident for days.\(^1^7\) Although sports health care professionals have been trained to remain wary of spleen injury following abdominal trauma, our experience has taught us that attention to signs and symptoms associated with liver injury is of vital importance as well.

ACKNOWLEDGMENTS

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The Performance Enhancement Group Program: Integrating Sport Psychology and Rehabilitation

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ABSTRACT: In an effort to improve the psychological health of the athlete who has sustained an injury, the Performance Enhancement Group program for injured athletes was created. This paper will offer a model for the Performance Enhancement Group program as a way to: 1) support the athlete, both mentally and physically; 2) deal with the demands of rehabilitation; and 3) facilitate the adjustments the athlete has to make while being out of the competitive arena. The program consists of responsibilities for professionals in sport psychology (ie, assessment/orientation, support, education, individual counseling, and evaluation) and athletic training (ie, organization/administration, recruitment and screening, support, application of techniques, and program compliance). The paper will emphasize that the success of the program is dependent on collaboration between professionals at all levels.

A significant injury in an athlete’s career can be a very difficult experience. As a result of the injury, treatment, and lengthy rehabilitation time, an athlete’s emotions can vary from frustration and anger, to confusion and even depression. With increasing athletic injury rates, sport psychology researchers are investigating the roles of performance enhancement techniques and social support and how they relate to the physical and emotional rehabilitation process.3,11,12

For example, in a survey of athletes with either knee or ankle injuries, participants who scored high on use of goal setting, positive self-talk, and mental imagery during rehabilitation exhibited extraordinary fast recoveries, while subjects scoring low on these factors evidenced slowest healing rates.5 Furthermore, it has been suggested that athletic trainers can assist athletes in coping with injuries using psychological skills training programs.9 It has also been suggested that social support can augment the athletic injury recovery process.9,10

The Performance Enhancement Group for injured intercollegiate athletes was created to integrate these research findings into a practical intervention following an injury. The main functions of the Performance Enhancement Group are to provide support to injured athletes by encouraging dialogue with peers in similar situations, allowing athletes to work one-on-one with individuals trained in sport psychology and learn performance-enhancement techniques that can accelerate the rehabilitation process.

To accomplish these goals, athletes meet weekly throughout an academic quarter. On average, the group consists of 8 to 10 male and female injured athletes from all sports, sport psychology interns who serve as facilitators, and undergraduate student athletic trainers. The costs of implementing the program are minimal because the sport psychology interns and student athletic trainers operate the group as part of their educational requirement.

The general framework (see Table 1) was created to accomplish both rehabilitation and education goals of the group. This model has been implemented at the University of California, Davis, and is currently in its fifth year of operation. This paper details the responsibilities of both sport psychology interns and athletic training staff and students.

SPORT PSYCHOLOGY RESPONSIBILITIES

The intervention section of the Performance Enhancement Group program is implemented by second and third year students working on masters degrees in sport psychology. The students, who work a full school year as part of their required internships, are supervised by instructors knowledgeable in injury rehabilitation. These students are responsible for the: 1) assessment/orientation, 2) support, 3) education, 4) individual counseling, and 5) evaluation phases of the program.

Assessment/Orientation

The program begins with an orientation. Sport psychology is introduced and the possible benefits of sport psychology approaches to the rehabilitation process are explained. A positive, educational approach is emphasized to dispel the negative stereotypes athletes might have about psychology. The facilitators explain the philosophy of the mind/body connection and its relationship to recovery from athletic injuries. This establishes an awareness of links between the benefit of rehabilitation sessions and the athletes’ attitudes and/or emotional states. The orientation further builds rapport between group facilitators and athletes, eases fears and anxieties, and provides a safe environment in which to work.
Athletes experience various emotional, behavioral, cognitive, and social responses following injury. For example, intercollegiate male athletes have shown increases in depression and anxiety scores and reductions in self-esteem scores following an athletic injury. Furthermore, these scores can sometimes reach levels similar to those of clients receiving outpatient psychotherapy. During the assessment/orientation phase, information is obtained via questionnaires and interviews to determine the athlete’s response to the injury. From the responses, specific individual needs are assessed, providing facilitators a starting point from which to structure subsequent meetings.

Support

The cornerstone of the Performance Enhancement Group program is the support phase which helps athletes understand their own responses to their injuries. The main purpose of this phase is to create an environment in which athletes feel they are progressing along with others who have suffered injuries. The meetings start with a “check-in,” where each member of the group shares that week’s rehabilitation successes and failures. Issues such as how their lives have changed and how their identities have been altered as a result of the injury are common themes in the weekly meetings. Because athletes share individual feelings and experiences, they gain emotional and cognitive support from each other.

Education

Education is emphasized in the third phase of the program. Here, athletes learn coping skills for both their injury and life events in general. Facilitators teach performance enhancement techniques, such as goal setting, relaxation, imagery, improved concentration, centering, time-management skills, and positive self-talk. Learning and applying these skills increases motivation for rehabilitation, coping skills for general academic demands, and confidence for the return to sport, and decreases the negative effects of career-ending injuries. Through discussions, facilitators and athletes explore possible links between personal factors (ie, locus of control, competitive trait anxiety, achievement motivation, daily hassles, etc), and increased risk of injury. This is done because research has shown that athletes high in life stress and competitive anxiety, and low in coping resources, exhibit higher injuries. Teaching athletes to monitor stress responses to competition and initiate a relaxation technique could decrease the chance of reinjury.

Individual Counseling

Athletes who participate in the Performance Enhancement Group program are required to attend at least one individual meeting with a facilitator. The athlete and facilitator work together to individualize the application of the performance enhancement techniques to the athlete’s particular situation. Many athletes choose to continue individual counseling throughout the academic quarter in conjunction with the weekly group meetings as a way to satisfy any personal needs not being addressed by the collective group. If necessary, facilitators make referrals to professionals for problems outside their scope of training.

Evaluation

The final phase involves evaluation. Athletes evaluate the strengths and weaknesses of the facilitators and the general approach of the program. Coaches, athletic trainers, the athletic director, and all facilitators meet to discuss possible changes and/or additions to the program. Additional individual counseling is given to athletes whose rehabilitation continues beyond completion of the group.

ATHLETIC TRAINING STAFF RESPONSIBILITIES

The structural implementation of the Performance Enhancement Group program is the responsibility of the athletic training staff. Acting as the liaison, the athletic training staff functions as the communication center for the involved groups (ie, between injured athletes and facilitators, the university administration and the needs of the Performance Enhancement Group, and finally the athletic trainers and the facilitators). This level has five specific functions which will be described in the next section: 1) organization and administration, 2) recruitment and screening, 3) support of the injured athlete, 4) application of techniques, and 5) program compliance.

An important member of the Performance Enhancement Group team is a senior student athletic trainer (program liaison) with an understanding of and interest in sport psychology. The student athletic trainer is selected and supervised by the staff certified athletic trainer, but is the sole representation from the athletic training staff at the weekly meetings. The student athletic trainer is responsible for coordination and communication between the certified athletic trainer, participating athletes, and group facilitators.

Organization and Administration

The basic operations of the program are identified and carried out by the student athletic trainer with the assistance of the athletic training staff. This includes locating a place, determining the time of day and length of the meetings, and ensuring that handout materials and other teaching tools are ready and available for use.

The meeting location should be easily accessible for all parties involved. Athletes attending these meetings are injured and must have appropriate accommodations. A quiet living
room atmosphere including comfortable furniture is required. It is important to create a warm and friendly setting to practice techniques in concentration and relaxation.

It is important when initiating the program to obtain the student-athlete’s time constraints, including practice times, study halls, and team meetings. This will allow for the most equitable day and hour to be chosen. Meetings need to be long enough to allow the facilitators to work effectively, yet not so long as to discourage the student-athlete from attending. One and one-half hour meetings are suggested.

Developing handouts, such as an informational brochure and/or a flyer reminding athletes of the weekly meetings, are also the responsibility of the student trainer.

Recruitment and Screening

The Performance Enhancement Group’s success relies solely on the student athlete’s willingness to participate. To encourage participation, a general orientation/informational meeting is held at the beginning of each academic quarter. The meeting is publicized and all coaches are recruited to attend for their own information, and to demonstrate support for the program. Athletes are referred and their attendance is monitored by a coach who is convinced of the program’s validity. To further assist the coaching staff in understanding the importance of the Performance Enhancement Group, individual meetings between the facilitators and head coaches have been helpful.

The athletic training staff is asked to identify student athletes who are “at risk” (ie, postoperative, chronically injured, or currently injured) and encourage their attendance at the orientation meeting by written invitation. An invitation is also extended to former members of the Performance Enhancement Group who would be willing to talk about their experiences in the program. A high profile athlete’s input lends credibility to the benefits of participation in the Performance Enhancement Group. During the remainder of the quarter/sport season, the athletic training staff continues to identify candidates. Student athletes are educated by the staff athletic trainer about the Performance Enhancement Group, because at times the athlete entertains misperceptions about the program.

The advertisement of the Performance Enhancement Group must be maintained throughout the year. It is mentioned at athletic department meetings/functions (eg, Captains Council meetings, peer adviser meetings, etc). The head athletic trainer describes the Performance Enhancement Group program, including its structure and benefits at the initial meeting of the year for each intercollegiate team, and wall posters hang in high use areas of the athletic facilities. Flyers are made each week to advertise specific topics being presented.

An effort is made to minimize any preconceived negative images that psychology or mental health might have. The athletic training staff helps project the positive, educational approach taken by the sport psychology facilitators. Consistent with this image and approach, the title “Performance Enhancement Group” was chosen, as opposed to “Support Group.”

Support of the Injured Athlete

The athletic training staff initiates the support phase by providing the immediate medical care and subsequent network of encouragement during rehabilitation. The team physician, student health center, and athletic training staff follow the athlete’s physical injury and progressive return to sport. Because of close daily contact with the injured athlete, the athletic trainer is able to promote a positive image and physical well-being. Conversations concerning the group’s progress and focus, as well as the application of techniques learned, can be initiated. The opportunity to vent frustrations is also available in the athletic training room, but the Performance Enhancement Group takes this a step further by providing the intersport support.

Application of Techniques

The value of the program is dependent on the participant’s ability to apply the performance enhancement techniques. It is vital for the student athletic trainer to remind the athlete to practice the skills. Using imagery to correct improper techniques or focus on pain-free range of motion during pool therapy are ways to improve confidence in the use of an injured limb. Many of the mental exercises can be performed during therapies such as whirlpool, bike riding, ultrasound, and electrical muscle stimulation.

During the year, graduate student facilitators provide in-services for the athletic training staff on the sport psychology techniques employed by the Performance Enhancement Group participants. In-services are important to allow athletic trainers to experience the techniques and to demonstrate how to integrate these skills during therapy. The in-services teach the staff to “listen,” identify with the injury and the frustration, and provide a positive support network for the injured athletes.

Program Compliance

The student-athlete’s social and academic time is demanding and structured, yet compliance is an essential ingredient for success. The only rules of the Performance Enhancement Group that the student athlete must adhere to are: 1) he/she must have at least one individual meeting with a facilitator, and 2) he/she must commit to attending each session during the academic term. The athletic training staff reminds the athlete of the weekly meetings. This is accomplished since all the Performance Enhancement Group participants use the athletic training facility on a daily basis. The student athletic trainer keeps attendance records and follows up with phone calls if needed to ensure that athletes adhere to their agreed-upon commitment. If needed, a reminder is sent to the coach for added support.

CONCLUSION

Informal feedback from athletes seems to suggest a difference in the way athletes who participate in the Performance Enhancement Group approach their rehabilitation and return to
Table 2. Feedback From Athletes Who Have Completed the Performance Enhancement Group Program

It was definitely a place I could let myself go and I needed that almost every week.

—Female, Cross Country and Track

I liked the fact that I could come to a place where other people understand, or at least have a concept of what I am going through. I also liked the fact that people finally told me it was OK to feel angry or sad about my situation and what I can do to help myself with it.

—Male, Basketball

I liked the positive self-talk best because it helped me with my self-esteem. I learned to change my perspective and look at things more positively and stop myself from being in total depression.

—Female, Swimming

I got the feeling the breathing helped me the most. It was easy to understand and simple to put into my daily routine.

—Male, Wrestling

sport. Table 2 lists some of the feedback from athletes who have filled out evaluations. The strongest indication of the effectiveness of the Performance Enhancement Group program comes from the number of referrals of friends/teammates by former Performance Enhancement Group participants.

Collaboration between professionals must be emphasized at all stages of the program. The athlete's progress should be reported to coaches, sport physicians, athletic trainers, the athletic director, and all interns. By taking a team approach to the Performance Enhancement Group program, the welfare of the individual athlete is always the number one priority.

ACKNOWLEDGMENTS

The authors wish to thank all the student athletic trainers and interns who have conducted a Performance Enhancement Group program over the past four years: Melissa Hughes, Anna Brockmeyer, Glen Rogers, Kerrie Brooks, Jody Romero, Betty Sears, Rob Lathrop, Lisa Glendenning, Tina Parly, Diane Gardetto, Tiffany Kuhn, Alette Coble, and Todd Speed.

REFERENCES

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Glenohumeral Joint Impingement in Swimmers
Debbie King, ATC

ABSTRACT: The purpose of this paper is to look at the different motions swimmers produce while practicing their sport and how these different motions cause problems with glenohumeral joint impingement, or “swimmer’s shoulder.” All four competitive strokes were analyzed to determine their effect on shoulder pain. Reasons for swimmers’ impingement problems include long and demanding training seasons, lack of strength and flexibility, hypovascularity in the rotator cuff tendons, and different bony configurations that may predispose athletes to shoulder pain. Current methods of prevention of glenohumeral joint impingement syndrome include strengthening and flexibility exercises and supervision of proper stroke mechanics. Treatment includes the use of modalities, such as ice, ultrasound, electrical muscle stimulation, NSAIDs, and pain-free exercises.

Shoulder impingement syndrome, or “swimmer’s shoulder,” is the most common complaint of injury given by swimming athletes. According to McMaster and Troup, 50% to 80% of swimmers will suffer from shoulder pain some time during their career. With such high incidence, it is important for both coaches and swimmers to be aware of conditions and practices that can cause painful problems in the shoulder.

ANATOMY

Shoulder pain in swimmers is often related to the rotator cuff muscles, the long head of the biceps tendon, and the subacromial space. The rotator cuff is comprised of four muscles; the supraspinatus, the subscapularis, the infraspinatus, and the teres minor. The rotator cuff has three main functions: humeral head depression, active external rotation of the shoulder, and stability of the glenohumeral joint. These muscles must hold the humeral head within the glenoid, allowing the more powerful muscles about the shoulder to be active above the shoulder level. If any muscles of the rotator cuff are weak, torn, or inflamed, problems may occur throughout the shoulder.

The subacromial space is made up of three bordering structures: the acromion process, the coracoid process, and the coracoacromial ligament. The supraspinatus passes through this space, and the biceps tendon passes directly under the supraspinatus. In certain shoulder and arm positions, the humeral head moves under the arch and the tendons can be repeatedly impinged between the greater tuberosity of the humerus and the coracoacromial arch. In this confined space, the tendon does not have much room for movement, nor does it have excess room to allow for inflammatory action. Impingement syndrome often begins as a case of progressive degeneration resulting from microtrauma to the rotator cuff. With the daily repetitive actions of swimmers, gradual wear and tear affects the structures important to the glenohumeral joint. This wear and attrition causes partial tears or microtears to the muscle tendons. Different shoulder positions causing this wear and tear will be discussed further when analyzing the different strokes and points during the stroke when impingement occurs.

According to Fowler, impingement is graded into three stages. Stage 1 is the beginning stage of the tendinitis, causing some edema, hemorrhage, and the beginning of the inflammatory process. Stage 2 involves thickening and fibrosis of the soft tissue structures. Stage 3 involves advanced conditions of shoulder impingement, such as rotator cuff tears, biceps tendon ruptures, and osteophytic bony changes under the acromion process. At stage 3, much pain and degeneration is involved. A swimmer who has tendinitis at this level cannot swim. The problems addressed in this paper will generally involve stage 1 and stage 2 levels of impingement. Stage 3 often requires surgery or, at a minimum, a prolonged rest period for the athlete who wants to continue to compete or even participate in the sport.

BIOMECHANICS

Four strokes are used in competitive swimming: freestyle or front crawl stroke, breaststroke, backstroke, and butterfly.
Freestyle

The fastest, most popular, and most widely used stroke for training is the freestyle stroke. The cycle of the freestyle stroke is broken down into three phases: the entry and first half of the pull, the end of the pull, and the recovery. During the entry and beginning of the pull phases, the glenohumeral joint is in forward flexion, and the humerus is in abduction and internal rotation. During the pull phase, the joint is extended and the humerus is in abduction and internal rotation. During the recovery period, the arm is in abduction and internal rotation, moving from extension to flexion above the water. Power for the crawl stroke comes 80% from the pull and 20% from the kick. Pain for swimmers may be elicited at different phases of the stroke. According to Fowler, who studied a group of competitive swimmers with reported shoulder pain, the onset of pain during the phases of the freestyle stroke varied. Pain was reported by 47.1% of subjects during the entry and first half of the pull phase; 14.3% reported pain during the end of the pull; 23.2% reported pain during the recovery; and 17.8% reported pain throughout the stroke.

Backstroke

The backstroke is considered the complement to the front crawl in that the arm actions involve the same three phases. During the entry, the shoulder is abducted to 180° and the arm is externally rotated with a straight elbow. During the pull-through phase, the arm moves into adduction and internal rotation. During recovery, the shoulder is flexed and moves above the water into the 180° abduction and external rotation position for the entry. Power comes 25% from the kick and 75% from the pull, which is slightly different from that of the front crawl. The greatest moment of pain during the backstroke tends to happen in the entry and the first half of the pull phase.

Butterfly

The butterfly stroke produces the highest incidence of shoulder pain. In a study done by McMaster and Troup, a total of 1262 swimmers, levels ranging from youth to masters, were surveyed about pain while using the butterfly stroke. It was unanimous throughout the groups that performing the butterfly produced the greatest amount of pain when suffering from “swimmer’s shoulder.” In a study done by Richardson et al, 81% of swimmers with bilateral pain listed the butterfly as their first- or second-best stroke.

The butterfly is performed with the arms in the same phase of the stroke at one time, in contrast to the previously discussed strokes, where each arm is in a different phase at a given time. During the entry of the butterfly, both shoulders are flexed, abducted, and internally rotated. During the pull-through phase, the shoulders move into extension. During the recovery, the arms are brought above the water from extension to flexion while abducted and internally rotated, using a slightly bent elbow (approximately 10° to 20° of flexion). An athlete’s power comes 30% from the kick and 70% from the pull when performing the butterfly. The greatest degree of pain seems to occur during a major portion of the stroke—the late portion of the recovery through to the first half of the pull.

Breaststroke

The breaststroke tends to produce the least incidence of shoulder pain. This stroke has a fifty-fifty split from where the power is initiated, the kick and the pull, using a bilateral motion like that of the butterfly. During the beginning of the pull phase, the shoulders are abducted, the arms are internally rotated, and are below the water surface. During the pull phase, the arms move into adduction, remain internally rotated, and are always below the water surface. During the recovery, the arms return in a circular pattern, always under the water surface.

As previously mentioned, the highest incidence of shoulder pain occurs in butterfly swimmers. According to Katz and Madders, the next highest incidence occurs in freestyle swimmers, although there is conflicting evidence whether distance swimmers or sprinters have more problems with shoulder pain. The third highest incidence occurs with backstrokers; then, finally, breaststrokers. For the first three strokes, injured swimmers report pain during the given stroke as well as during the training stroke (the front crawl). Breaststrokers tend to have pain initially during the front crawl; then breaststroking movements are later affected. Because breaststrokers rely less on upper body power than with any other stroke, the breast-stroke seems to be less of a causative factor in shoulder pain. Conversely, breaststrokers do not have notably less incidence of shoulder pain, because 99% of swimmers do the main portion of training with the front crawl.

Causal Factors

There are various causes or contributors to causes of shoulder impingement problems in swimmers. Among these are: overuse, bony configuration of the shoulder complex, hypovascularity, muscular imbalance, joint stability, flexibility, stroke technique, and coaching factors.

Overuse

Overuse is a problem of primary concern. For age-group swimmers as well as elite swimmers, practice sessions can take 4 to 5 hours of the day for a minimum of 5 days per week. During this time frame (generally broken up into two sessions per day), swimmers log as much as 8000 yards per day and more, up to 20,000 yards (11.4 miles) per day by elite-level swimmers. In a standard competition 25-yard pool, a swimmer averages 6 to 12 stroke cycles per length (depending on level and/or gender). A swimmer who completes a 10,000-yd swim performs from 2400 to over 4000 overhead strokes per session, not accounting for fatigue, when the swimmer may take more stroke cycles to travel the length of the pool. Swimming is equated to running for energy expenditure in a ratio of 1:4 in that running 4 miles is equivalent to swimming 1 mile. Following this ratio, an athlete who swims 10,000 yards per
day, or 5.7 miles, is expending energy comparable to running over 20 miles per day. Of course, it is important to consider the body weight and force differences in swimming vs running, but, nonetheless, it is evident that swimming places high demands on the athlete.\textsuperscript{15} Because swimming is so dependent upon upper body strength (as seen in the pull vs kick power ratios of each stroke), smaller muscle groups such as those of the rotator cuff are put to the test to stay healthy.\textsuperscript{9,15} It is estimated that 50% to 80% of competitive swimmers experience shoulder pain at some time in their careers to the extent that their training is interrupted.\textsuperscript{15} Richardson et al\textsuperscript{17} reported a study in which a 67% incidence of shoulder pain was reported at a given time in a group of male collegiate swimmers. McMaster and Troup\textsuperscript{14} found incidence ranging from 47% to 73% of swimming athletes (including both genders and all skill levels) who experienced shoulder pain at some time in their careers. With the rigorous training schedules of swimmers, overuse may seem inevitable; but it remains a major factor in the cause or partial cause of microtrauma and impingement syndrome.\textsuperscript{14,15,17}

Bony Configuration

The bony structure of the acromion process may predispose an athlete to potential impingement problems.\textsuperscript{15} There are three different classified types of acromions: Type I is the most common type—the undersurface of the acromion is flat. Type II acromions are curved, and type III acromions are hooked. Both type II and III acromions are considered to be congenital anomalies and may predispose a swimmer to impingement syndrome.\textsuperscript{1,7,18} The dimensions of the subacromial space in type II and type III are decreased, often involving excess osteophytes upon the undersurface of the acromion. Tendinitis problems are more easily developed because this abnormal bony configuration may cause wear and attrition to the tendon from constant friction on the muscle.\textsuperscript{7} Unfortunately, there are no rehabilitation exercises that will assist in conservative management for a curved or hooked acromion; it is a structural problem. If tendinitis problems develop in someone with a type III acromion, rehabilitation can be attempted, but, overall, this person will have great difficulty in overcoming the problem.\textsuperscript{1,4,18}

Hypovascularity

Hypovascularity of the supraspinatus tendon repeatedly occurs during swimming strokes, leading to problems of shoulder impingement.\textsuperscript{4,15} When the shoulder is abducted, all vessels of the supraspinatus tendon are well vascularized or almost completely filled with blood. When the arm is at the side of the body, the tendons are stretched tightly over the head of the humerus and there is an area of constant avascularity from 1 cm proximal to the insertion point to the area of insertion.\textsuperscript{15} When the arm is moved back into abduction, the vessels are refilled. Fowler\textsuperscript{3,4} and Murphy\textsuperscript{15} refer to this phenomenon as a “wringing out” mechanism. This action, repeated again and again, may cause degenerative changes in the tendon. While swimming, the arms move in and out of this area of hypovascularity with each individual stroke, thus repeatedly “wringing out” the supraspinatus over 2500 times in a 2-hour session. Because the tendon is not well vascularized throughout the motion, this may lead to chronic irritation and degeneration. The inflammatory process will begin, causing the tendon to exceed the size of comfort for the given space and thus causing pain.\textsuperscript{4,8,15}

Muscular Imbalance

Swimming emphasizes adduction and internal rotation of the shoulder during the propulsive phases of the different strokes.\textsuperscript{9,10} In swimmers, the muscles that produce these actions, mainly the latissimus dorsi, pectorals, subscapularis, and teres major, generally have greater strength and can produce more torque than those muscles of the average nonswimming athlete.\textsuperscript{3,5} When these muscles are compared to the external rotators of the shoulder, the teres minor and infraspinatus, swimmers generally have similar strength and torque values as their nonswimming counterparts. Although swimmers do not have underdeveloped external rotators, the extreme development of the opposing group causes a significant muscular imbalance.\textsuperscript{3,14} In an unpublished study by Fowler,\textsuperscript{3} a group of competitive swimmers was compared to a control group. The control group consisted of people who participated in activities that did not require great arm rotation strength. Internal and external glenohumeral rotation strengths were measured in three positions: the arm in neutral (anatomical) position, the humerus in 90° abduction, and the humerus in 90° flexion. In the swimmers, the torque ratios for internal rotation were significantly higher than those of the control group. This would be attributed to the power-specific strength that swimmers strive for, to excel in the sport. There were no significant differences between the swimmers and the control group when comparing the external torque ratios, thus indicating a significant muscular imbalance between the internal and external rotator muscles of the swimmers.\textsuperscript{4,15,16}

McMaster et al\textsuperscript{13} reported results similar to Fowler. Although the swimmers showed significantly more strength in internal rotation, strength in external rotation was normal as compared to the control group, again displaying the muscular imbalance in swimmers. One of the main functions of the rotator cuff musculature is to depress the humeral head in order to minimize the degree of subacromial impingement while overhead movement is occurring.\textsuperscript{3,4} If there is a significant imbalance in the rotator cuff muscles, the muscles of the opposing functions (the internal rotator vs external rotators) might overcome the opposite group. The muscles will no longer work together efficiently, the humeral head will not remain depressed as needed, and the problem of imbalance will assist in causing subacromial trauma, or impingement syndrome.\textsuperscript{4,13,16}

The scapular muscles, the trapezius, the serratus anterior, and the rhomboids work constantly during the swimming arm action to stabilize not only the back but also the trunk and glenohumeral joint.\textsuperscript{3,4} If these muscles fatigue, the scapula may begin to tilt downward, which becomes significant with the continuous repetitions in swimming in that any amount of abnormal tilting may cause alterations in the mechanics of the
Joint Stability

In a study of patients (not swimmers) with anterior joint instability, 68% showed positive impingement signs. Fortunately for the swimming athlete, swimmers do not tend to have high incidence of anterior joint instability, with the exception of backstrokers. The troublesome point of the stroke occurs just after the hand enters the water when the shoulder is externally rotated, flexed, and in maximal abduction. The swimmer reaches for the extreme end of the range of motion which may propel optimal movement though the water, but, in turn, moves the humerus awkwardly within the glenohumeral joint and can cause instability problems.

Posterior joint instability is more prevalent in swimmers, as well as in the population as a whole. In a study done by Fowler and Webster, 55% of swimmers tested were found to have posterior joint laxity, while 52% of the control group showed positive signs. The “at risk” position for athletes with posterior joint laxity is forward flexion and internal rotation, a repeated action in all swimming strokes. Swimmers with significant posterior joint instability may actually dislocate or sublux their shoulders during the swimming motion.

Flexibility

Swimmers and athletes in general tend to overlook the importance of flexibility in their fitness programs. Flexibility of the glenohumeral joint capsule and the muscles stabilizing it are key components in avoiding shoulder tendinitis problems. According to a study by Greipp, the more flexible the swimmer, the less incidence of shoulder pain. Body roll may help to compensate for lack of flexibility, but, for optimal performance, stretching exercises should be an important part of the workout. Body roll and flexibility may help to explain why swimmers who compete in the butterfly stroke have a higher incidence of shoulder pain. A proper butterfly stroke gives no allowance of body roll to compensate for lack of flexibility. Good range of motion is important in all swimming strokes, but especially for the athlete who swims the butterfly. A flexible back is needed to achieve optimal body lift, while a flexible shoulder is important to perform the bilateral stroke without any assistance in body roll.

Stroke Technique

Inefficient swimmers put undue stresses on the glenohumeral joint at different points during the stroke, causing degeneration and pain when combined with repetition in training. Videotape analysis shows a direct correlation between swimmers without shoulder pain and those who complete the recovery at the halfway point of the freestyle stroke; in other words, moving from external rotation to internal rotation at optimal position. External rotation during the first 90° of abduction allows greater tuberosity of the humerus to roll posteriorly and clear the subacromial arch where impingement occurs. Strength and equal endurance of the external rotators to the internal rotators is important because swimmers who internally rotate too early may have increased problems with impingement.

Body roll is an important factor in technique in that a body roll of 40° to 60° is optimal during recovery of freestyle and backstrokes. If body roll is not adequate, the arm may have to excessively externally rotate in order to initiate recovery and may cause abnormal stresses on scapular tension. If body roll is excessive, the action could lead to crossing of the arms during the entry or the pull-through phase, also causing excessive stress and inefficiency. Overall, the greater the efficiency of the swimmer, the less energy is spent to compensate for excessive movement and resistance and less strain per stroke is put on the shoulder.

Coaching Factors

Coaches can act to avoid or stop shoulder pain not only by being aware of the signs and problems of overuse, but also by understanding the biomechanics of each stroke and whether or not their swimmers are performing efficiently. A coach should be able to recognize by visual observation or videotape if, for example, a swimmer performing the freestyle stroke is moving into internal rotation too early during the recovery. Overall, the coach should not only be aware of all discussed causal factors, but also of which drills or activities, such as using hand paddles while practicing pulling, tend to cause a higher incidence of shoulder pain. The coach can then implement a complete training program, including dry-land exercises for strength and flexibility, for optimal performance and happiness of the athletes.

PREVENTION AND TREATMENT

The best prevention for shoulder impingement syndrome is an awareness of the causal factors and the know-how for avoiding or compensating for rising pain. An athlete who participates in “prehabilitation” is more apt to avoid shoulder problems because prevention is the best treatment. Preventive measures might include gradual (vs extreme) increases in training yardage, strengthening exercises especially for the external rotators of the shoulder, exercises for good flexibility and range of motion, and continual consideration by the coach of the athlete’s stroke mechanics and efficiency. If shoulder impingement problems have already begun, an athlete must decrease yardage, or take some complete rest time, depending on the severity of the pain. Ice, NSAIDS, ultrasound, or electric muscle stimulation may aid the recovery process. As soon as possible after the onset of the injury and treatment, the athlete can begin pain-free strengthening and flexibility exercises, emphasizing pain-free action, or the athlete may find him- or herself worse off than during the original state.

The most common injury occurring in swimming athletes is shoulder pain or shoulder impingement, thus giving the phenomen-
enon its own name, “swimmer’s shoulder” (although all types of athletes suffer from the problem). The biomechanics and nature of swimming may seem to predispose all swimmers to unavoidable pain sometime in their career, but with careful attention to a complete and balanced workout program, swimmers have the potential to remain painfree.

In conclusion, swimmers and coaches need to be aware of the high incidence of shoulder impingement syndrome, and thus take the steps needed to keep the problem under control. By understanding the basic anatomy of the glenohumeral joint, the basic biomechanics of each stroke, and how the movements can cause shoulder problems, athletes and coaches alike can attempt to attack underlying causative factors of the pain. By recognizing the different causal factors, such as overuse, muscle imbalances, and flexibility, steps can be taken to control extrinsic factors leading to impingement syndrome. Finally, by understanding some concepts in prevention and treatment of the problem, swimmers can have the best chance of controlling or even avoiding this prevalent problem.

REFERENCES

18th 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 must be on a topic germane to the profession of athletic training and can be case reports, literature reviews, experimental reports, analysis of training room techniques, etc.
3. Entries must not have been published, nor be under consideration for publication by any journal.
4. The winning entrant will receive a cash award and the paper will be published in the *Journal of Athletic Training* with recognition as the winning entry in the Annual NATA Student Writing Contest. One or more other entries may be given honorable mention status.
5. Entries must be written in journal manuscript form and adhere to all regulations set forth in the “Authors’ Guide” of the *Journal of Athletic Training*. We suggest that, before starting, you read: Knight KL. Tips for scientific/medical writers. *J Athl Train.* 1990;25:47–50. NOTE: A reprint of this article, along with other helpful hints, can be obtained by writing to the Writing Contest Committee Chairman at the address below.
6. Entries must be received by March 1, 1996. Announcement of the winner will be made at the Annual Meeting and Clinical Symposium in June.
7. The Writing Contest Committee reserves the right to make no awards if, in their opinion, none of the entries is of sufficient quality to merit recognition.
8. An original and two copies of the paper must be received at the following address by March 1, 1996.

NATA Student Writing Contest
Deloss Brubaker, EdD, ATC
Life College
1269 Barclay Circle
Marietta, GA 30060
Portfolios: An Alternative Method of Student and Program Assessment
Susan E. Hannam, HSD, ATC, CHES

ABSTRACT: The use of performance-based evaluation and alternative assessment techniques has become essential for curriculum programs seeking Commission of Accreditation of Allied Health Education Programs (CAAHEP) accreditation. In athletic training education, few assessment models exist to assess student performance over the entire course of their educational program. This article describes a model of assessment—a student athletic training portfolio of “best works.” The portfolio can serve as a method to assess student development and to assess program effectiveness. The goals of the program include purposes specific to the five NATA performance domains. In addition, four types of portfolio evidence are described: artifacts, attestations, productions, and reproductions. Quality assignments and projects completed by students as they progress through a six-semester program are identified relative to the type of evidence and the domain(s) they represent. The portfolio assists with student development, provides feedback for curriculum planning, allows for student/faculty collaboration and “coaching” of the student, and assists with job searching. This information will serve as a useful model for those athletic training programs looking for an alternative method of assessing student and program outcomes.

DESCRIPTION OF THE PORTFOLIO

Several types of portfolios are used in education. The type of portfolio described in this article is a collection of materials representing documented evidence of the scope and progress of the student’s “best works.” Athletic training faculty members regularly assess the development of student knowledge, skill, and attitudes from the evidence collected in the portfolio. This is a showcase portfolio that captures the quality of students’ efforts as well as their progress.

Designing the student athletic training portfolio began by examining established entry-level athletic training attitudes, knowledge, and skills, and by developing an adequate assessment tool. The five purposes specific to the performance domains of athletic training (prevention of athletic injuries; recognition, evaluation, and immediate care of athletic injuries; rehabilitation and reconditioning of athletic injuries; health care administration; and professional development and responsibility) provided the framework for selection of portfolio entries. The goals of the faculty in establishing the portfolio project were to create a collection of the students’ “best works” spanning the six-semester clinical program. Our objectives in establishing the portfolio project were fivefold: 1) to assist with the assessment of student progress toward becoming an athletic training professional, 2) to provide feedback in curriculum planning, 3) to allow faculty and student collaboration, 4) to allow for specific “coaching” of the student, and 5) to assist the student with job searching.

Collins classified four types of portfolio evidence: 1) artifacts, 2) attestations, 3) productions, and 4) reproductions (see Table). An artifact is a document produced by the student. For example, an artifact might be a paper written for a course, a lab report, a budget request, or a case study. An attestation is a document about the student, prepared by someone else. Attestations include letters of gratitude from a coach, letters of recommendation from a faculty or staff member, student evaluations from clinical experience, or letters of evaluation from an affiliate site. Productions are documents prepared...
Types of Portfolio Evidence

<table>
<thead>
<tr>
<th>Evidence</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artifact</td>
<td>Document produced by the student</td>
<td>Lab reports, budget, case study</td>
</tr>
<tr>
<td>Attestation</td>
<td>Document about the student</td>
<td>Letters of recommendation, staff evaluations</td>
</tr>
<tr>
<td>Production</td>
<td>Produced specifically for the portfolio</td>
<td>Reflections (captions) of documented</td>
</tr>
<tr>
<td>Reproduction</td>
<td>Representation of the student's work as an athletic trainer</td>
<td>Photographs of bulletin board, videotapes</td>
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</table>

especially for the portfolio. Reflections on documented accomplishments and caption statements about the learning process are examples of productions. A reproduction is a representation or an example of a typical event in the student’s work as an athletic trainer, which is usually not documented. Examples include photographs of a bulletin board or poster created by the student or a videotape of a class presentation.

Caption statements are the most important part of the portfolio documents because they convert the documents into evidence.5 Caption statements must be present to distinguish a portfolio from a mere collection of student work. In the caption statement, the student articulates precise thinking about how the document assisted in learning. The student reflects on the thinking process (metacognition) while completing the project/assignment. Faculty members encourage comparisons between recent and earlier-documented evidence placed in the portfolio. This gives the evaluator (the faculty/staff or perhaps an external review board) an opportunity to assess whether the student has bridged the gap between theory and practice. For example, students sometimes realize that the work they did was not consistent with their intentions or beliefs.4 Students are asked to answer the following questions on a cover page for each portfolio document as caption evidence: 1) What is the document? 2) What is the evidence type? 3) Why is the document evidence? and 4) What did you learn from the experience? Caption statements need not be elaborate. They may be a simple title sheet indicating what the document represents and why it is important.

**MATCHING EVIDENCE WITH GOALS**

The Figure shows the page on which the five goals, the four categories of evidence (with several specific documents required of everyone), and the academic year of evidence submission are tabulated.

Examples of record keeping are submitted the first semester a student attempts medical record writing. Typically, the best example of an entire rehabilitation record for an injury case and the injury evaluation (eg, SOAP notes) are submitted. In this case, students include a caption for each document explaining why this effort is evidence of their best record keeping to date and describing what they learned by choosing their best work. The rehabilitation record is evidence of achieving the athletic training rehabilitation and reconditioning goals; the SOAP note falls under the health care administration goal. Annual samples of record keeping are submitted when the student determines that he or she has improved in skill. Submissions are kept in the portfolio as reference points for student and faculty/staff collaboration. Medical record-keeping proficiency and improvement are readily determined and monitored by this method.

Research papers are required in several athletic training classes. These are submitted with captions. Perceptions of quality are written in the caption statement to address what the student learned. This evidence provides an opportunity for faculty/staff to gain insight into the student’s ability to reason and communicate in writing. Research papers often are submitted as rehabilitation and reconditioning evidence if completed for the therapeutic exercise and therapeutic modalities classes, or submitted as recognition, evaluation, and immediate care of athletic injuries evidence if completed for the physical evaluation of athletic injuries class. Because it is a portfolio of best works, students often replace sophomore papers with later papers as their ability to perceive and assess the quality of their work increases (all entries remain in the portfolio for comparison purposes). Students, with the assistance of faculty members, write a caption statement clearly indicating how and where the quality has improved. It appears that the ability to perceive change is initially an outcome of the directed process of faculty/staff collaboration and feedback. Students who develop strong critical thinking abilities appear to naturally develop the ability to perceive improvement.

For reproductions, a blank videotape is purchased and kept by the student at the beginning of the sophomore year. Students tape record all class presentations and the practical portion of examinations. In most cases, vast improvement occurs from one semester to the next. The videotape as reproduction evidence may fulfill a number of goals across the entire program.

Other reproduction entries are made for both Professional Development and Responsibility and Prevention goals. In the sophomore year, students are required to become “mini experts” in one audiovisual area (eg, bulletin boards, overhead transparencies, etc) as part of a formal class. They present the proper use of an audiovisual aide to the class and then they use it to present an athletic injury prevention topic. Photographs of the bulletin board or of their presentation are put in the portfolio. Captions are required.

At least two attestation records are put in the portfolio each semester following staff evaluations of clinical skills. Captions have not been required for these documents because students verbally reflect on their performance during individual conferences with staff athletic trainers. Other entries that students submit as evidence of their best work include letters from coaches and special event administrators. The letters usually acknowledge and thank them for assistance with special activities/events (eg, assisting with Special Olympics or organizing medical coverage for a tournament).
Matching the five domains (goals) with portfolio categories of evidence.

The budget and facility design projects are completed during the senior year. Each student (or pair of students) is given a specific project scenario (college or high school size, number of sports, size of facility, and budget) and each is expected to complete the project with the requested paperwork and with a rationale for design and purchase. Students submit projects separately with a caption statement attached. The caption includes reflective statements on skills specific to the project, procedures employed to complete the project, and learning experiences. Captions are revealing because they often indicate student values and thought processes. Both projects are submitted as evidence of achieving organization and administration goals.

**DISCUSSION**

Several of our recent graduates indicate that producing the portfolio assisted them in providing evidence of their abilities during job interviews. In addition, the critical thinking skill and dispositions scores will be used by above-average students as evidence of their problem-solving ability to employment or graduate school selection committees.

We are entering our third year of using the portfolio. It has served as a valuable tool for discovering the following potential areas of program concern: the quality of students' reflection on their work, and the weakness of the evidence in some of the five goal areas. Specifically, a review of graduating senior portfolios showed that some students had limited exposure and assignments in some goal areas. Students were meeting NATA BOC requirements, but our curriculum did not require sufficient evidence of work in the goals for the psychology/counseling competencies. We are attempting to develop specific course requirements to meet these goals.

The potential growth for both the student and the program as a result of portfolio use appears unlimited. It is restricted only by the goals and type of portfolio that faculty/staff want to institute. For example, this paper has discussed a portfolio of best works. Other types of portfolios could be created to document competency acquisition, to represent all work completed by students, or to use as a course portfolio. In the initial stages, the process requires time for meeting and explanation. The success of this method of student and program assessment is also contingent upon consistent monitoring of individual student progress. Students seem to thrive on being told about their professional growth. Often, they develop the skills to self-assess as they become more proficient at identifying evidence.

The five objectives for the portfolio developed by the faculty seem to have been met: 1) it has assisted in assessing student progress by providing evidence of student work over time; 2) it has provided invaluable feedback for curriculum planning and preparing for CAAHEP review; 3) it requires faculty/student planning and therefore fosters collaboration; 4) it provides an effective avenue for mentoring students; 5) several students have taken the portfolio with them when interviewing for a position.

We are beginning to discover the many uses of the portfolio. While there is a paucity of literature on methods of scoring portfolios, we have obtained valuable information to assist both the students and the program. The faculty's objectives for the portfolio must be kept in mind when developing specific assessment criteria. We are now in the process of using Spandel and Culham's suggested process of examining class
sets of portfolios and sorting them into “stacks” (inadequate, adequate, or exceptional) relative to the portfolio goals. Rubrics will be developed by identifying general characteristics of the quality of work found in each stack. Our next steps are to develop more explicit criteria, to train an advisory group of external certified athletic trainers, and to score graduating senior portfolios. The portfolio is one method of assessing the depth of understanding and abilities that students develop over time. Although the process is somewhat time-consuming, the quality of feedback to both students and faculty/staff has been well worth the effort.

REFERENCES
Surgical Treatment of Chronic Patellar Tendinitis in a Collegiate Football Player

Joel W. Beam, MEd, ATC; Philip R. Lozman, MD, ATC; John W. Uribe, MD

ABSTRACT: In the competitive athlete, there are many causes of anterior knee pain, one of which is patellar tendinitis. Repetition of explosive movements can cause microtrauma to the tendon and its insertion, resulting in patellar tendinitis and occasional tearing, either partial or total. Due to its refractory nature, the treatment of this disorder can be quite frustrating to all involved. A 20-year-old collegiate football player with patellar tendinitis was treated conservatively for more than 2 years. Despite aggressive training regimens, including quadriceps stretching, eccentric strengthening, and therapeutic modalities, the athlete was unable to participate at his preinjury level. Physical examination of his knee revealed inflammation and crepitation. Radiographs demonstrated an avulsion fragment from the inferior pole of the patella and magnetic resonance imaging showed cystic degeneration of the tendon. These findings confirmed the diagnosis of chronic patellar tendinitis. The patient underwent surgical debridement of the patellar tendon without complications. His postoperative rehabilitation was divided into three phases: passive range of motion, active strengthening, and sport-specific activities. At 14 weeks postsurgery, the athlete was able to return to his previous level of activity without pain. Follow-up 30 weeks postoperatively revealed no return of symptoms. At 40 weeks postsurgery, the athlete was participating at his preinjury level. This case report demonstrates the successful outcome of the surgical treatment of chronic patellar tendinitis, which was unresponsive to conservative treatment, in a competitive collegiate football player.

Patellar tendinitis is believed to be caused by an overload on the extensor mechanism at the bone-tendon junction of the inferior pole of the patella. With year-round training of collegiate athletes, this condition can result in modification of activity or loss of time on the playing field. Activities that require repetitive acceleration, deceleration, and jumping produce microtearing and degeneration of the patellar tendon over time. In this case, a 20-year-old collegiate football player developed chronic patellar tendinitis that did not respond to conservative treatment and ultimately required surgical intervention to allow him to return to competitive football.

CASE HISTORY

A 20-year-old male, football wide receiver, with a 2-year history of chronic right patellar tendon pain, was examined. His freshman knee exam had revealed no previous injury and was unremarkable regarding joint laxity, inflammation, and deficit in strength level. Throughout the 2-year period, he was treated conservatively with quadriceps stretching, eccentric strengthening, nonsteroidal anti-inflammatory medication, therapeutic modalities, and modification of activity. The modalities consisted of moist heat, ultrasound, phonophoresis, deep friction massage, ice, and electrical muscle stimulation for anti-inflammatory response and pain relief. Modification of his activity included elimination of bounding, squatting, active open chain knee extension against resistance, and running of stadium stairs. These measures allowed him to compete with minimal time loss, although the pain continued. By the end of his sophomore year, the player noticed a decline in his performance ability, secondary to chronic patellar tendinitis. Following the conclusion of the season, physical examination revealed pain and crepitation of the patellar tendon at the inferior pole of the patella. There was inflammation around the tendon, but no bilateral evidence of quadriceps atrophy or hamstring inflexibility. Radiographs of the right knee demonstrated a 3-mm long avulsion fragment adjacent to the inferior pole of the patella (Fig 1). Magnetic resonance imaging (MRI) revealed thickening of the proximal patellar tendon, with a 3-mm round cyst, consistent with tendinitis (Figs 2 & 3). There was a vertically oriented high signal region within the proximal patellar tendon suggestive of a longitudinal intrasubstance tear versus degeneration of the tendon.

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Fig 1. Lateral radiograph showing avulsion fragment adjacent to the inferior pole of the patella.
Based on the chronic nature of this athlete’s condition and his failure to respond to conservative therapy, he underwent surgical debridement of the patellar tendon. Through a single longitudinal incision centered over the inferior pole of the patella, the subcutaneous and paratendinous tissues were incised. The substance of the tendon was opened through an incision along its fibers. This revealed a fluid-filled cyst surrounded by degenerated tendon tissue. Approximately 1.5 cm² of degenerative tendon was excised from the inferior pole of the patella, which was subsequently denuded down to bleeding cancellous bone. The longitudinal defect in the tendon was closed side-to-side, as were the soft tissues covering the patellar tendon. Microscopic examination of the debrided material demonstrated fibrotendinous tissue with recent and organizing hemorrhage and marked fibrovascular reparative changes.

Following surgery, the patient was placed on crutches and allowed to bear weight as tolerated. Because of the small amount of tissue excised, it was felt the tendon was not significantly weakened and a brace for immobilization and stability was not necessary. The crutches were discontinued on the second postoperative day. On day 5, he began quad sets, straight-leg raises, and passive knee flexion. On day 17, he regained preoperative knee flexion, knee extension, and gait. For a period of 6 weeks following surgery, active open chain knee extension against resistance was avoided to allow healing of the tendon. Six weeks postoperatively, active strengthening was initiated. Eccentric strengthening of the quadriceps, hamstrings, and ankle dorsiflexors were performed using tubing, cuff weights, and a Biodex System 2 (Biodex Medical Systems, New York). Closed chain exercises including step-downs, wall slides, wall sits, and balance board proprioception were used to increase the strength of the gastrocnemius, soleus, tibiias anterior and posterior, and peroneal muscle group. At 12 weeks, he began jogging and slowly progressed into cutting and running of pass routes. At 14 weeks, he was able to participate in full activities at his preinjury level without difficulty or pain. Follow-up 30 weeks postoperatively revealed no pain or inflammation in the tendon, equal leg strength bilaterally, and an improvement in flexibility. He was performing all sprints, agility drills, and running of pass routes at his preinjury level. At 40 weeks postsurgery, he was participating in practice and competition at his preinjury level. Eccentric and closed chain exercises were used to maintain the strength level of his quadriceps and hamstrings. Bounding, squatting, active open chain knee extension against resistance, and running of stadium stairs were eliminated from his conditioning program.

**DISCUSSION**

Patellar tendinitis is a common cause of anterior knee pain in the competitive athlete.²,⁴ Considered a progressive disorder, three phases have been described²: phase 1) pain after activity only, no undue functional impairment; phase 2) pain during and after activity, still able to perform at a satisfactory level;
and phase 3) pain during and after activity which is more prolonged, with progressively increasing difficulty in performing at a satisfactory level.

A number of predisposing factors are believed to lead to the development of patellar tendinitis. Quadriceps inflexibility and atrophy, hamstring tightness, and patellar hypermobility have been described as important contributory causes. According to some authors, inflexibility of the hamstring musculature places excessive stress on the extensor mechanism which in turn may increase forces to the tendon during contraction. The type and frequency of training along with the training surface have also been implicated as causes. In 1986, Ferretti found that hard playing surfaces and increased frequency of training were the most significant contributory factors.

Early recognition and diagnosis is extremely important for effective treatment. Treatment is first directed with heat therapy, proper warm-up, stretching, eccentric strengthening, cold therapy following activity, and at least a 10- to 14-day period of nonsteroidal anti-inflammatory medication. As symptoms persist, nonsteroidal anti-inflammatory medication may be continued. Orthoses such as a neoprene sleeve or a patellar strap may be of some benefit. Activities that worsen the condition, such as running of stairs, bounding, and squatting, should be avoided. Local steroid injections have been proven to weaken the tendon and should not be used. Conservative treatment measures conclude with a prolonged period of rest and consideration of cessation of sport and similar activity.

Plain radiographs and MRI are the most commonly used methods to evaluate chronic patellar tendinitis. In cases where symptoms continue for more than 3 months, despite conservative treatment, radiographic studies may be warranted. Radiographic views should include anteroposterior, lateral, intercondylar, and patellar tangential views. Radiolucenties, elongations, or irregularities of the inferior pole may confirm the diagnosis. MRI should be considered with cases of continued pain and symptoms which interfere with activity, with normal or abnormal radiographs. MRI can reveal a more complete delineation of the pathology and degeneration at the bone-tendon junction as well as within the tendon itself. Surgical intervention should only be considered after unsuccessful attempts of conservative therapy. Constant pain, inflammation, impairment of sport activity, and a visible or palpable enlargement of the tendon are clinical findings which may indicate the need for surgery. Radiographs and MRI can confirm the clinical findings and define the area and extent of the tendon degeneration. Some believe that for the competitive athlete, only surgical treatment provides long-lasting relief.

Various forms of surgery have been described for the treatment of patellar tendinitis, all of which involve debridement of the degenerative tendon. The results of procedures involving detachment and reattachment of the patellar tendon from the inferior pole of the patella have been disappointing, based on the unpredictable healing of the bone-tendon junction. However, those techniques which involve debridement alone have proven more successful with a return to sport-specific activity within 3 to 6 months.

A number of different rehabilitation protocols have been suggested for postsurgery. Immobilization in full knee extension from 4 to 6 weeks followed by active strengthening has been advocated. Colosimo emphasized the importance of bearing weight and knee range of motion immediately postoperatively within patient tolerance levels. However, he warned of an 8- to 12-month period before full activity was completely pain-free. In our experience, early postoperative passive and active knee motion and a 6-week avoidance of open chain quadriceps strengthening against resistance allowed an early return to sport-specific activity.

CONCLUSION

Competitive athletes present a challenge regarding the treatment of patellar tendinitis. This is especially true in athletes who fail to respond to conservative therapy. In these cases, the failure to respond is believed to be the result of performance demands that restrict prolonged periods of rest. For these reasons, athletes can be faced with the decision to cease their activities or undergo surgery as a final alternative. This case report demonstrates the use of operative intervention and carefully designed postoperative rehabilitation for the treatment of chronic patellar tendinitis in a collegiate football player.

REFERENCES

 Silicone rubber was first introduced to the athletic training field in 1979 for use as playing cast material. When dry, the silicone rubber becomes a semirigid cast providing support and protection to the injured body part. A variety of injuries have been casted using this technique, ranging from fractures and dislocations to severe sprains to the hand and wrist areas.

There are several techniques for applying silicone rubber, specifically RTV-11 silicone rubber, reported in the literature. One disadvantage of RTV-11 is that it must be mixed and used within a set period of time. Depending upon the size of the area being casted and the uniqueness of the casting, there can be RTV-11 material that is mixed and not used. In this age of budget tightening, this wasted material can become costly over time.

Over the past 15 years, I have produced a wide variety of silicone rubber casts in a different manner from that of RTV-11. I purchased tubes of 100% silicone rubber caulking (white or clear) ranging in price from $4 to $6 and a caulking gun for $6 from the local hardware store. I can make from one to three casts per tube of silicone rubber caulking with no mixing, with less mess than with RTV-11, and with no waste.

**MATERIALS**

(See Fig 1)
- Caulking gun with a tube of caulk
- Scissors
- Foam prewrap
- Light elastic tape
- Stockinette
- Flexible roll of gauze
- Tongue depressors
- Old towel/sheet for drapes
- (If needed) donut pads and 4 × 4 gauze pads
- Latex gloves
- Plastic wrap

**PROCEDURE**

1. First, apply a latex glove and plastic wrap to the injured area. Then prewrap and tape the area to be casted for support and safety while casting (Fig 2).
2. Apply a stockinette to the area longer than the actual cast length (Fig 3).
3. Cut the tip of a 100% silicone rubber tube and punch a hole in the inner seal.
4. Apply a coat of silicone over the entire area to be casted and smooth it out with a tongue depressor (Fig 4).
5. Apply one layer of roll gauze over the wet silicone, making sure that silicone oozes out between holes in the gauze (Fig 5).
6. Apply a second layer of silicone over the gauze and smooth it out with a tongue depressor.

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7. Apply a second layer of roll gauze over the silicone, making sure that the silicone oozes out between holes in the gauze.
8. If a donut pad is needed for extra protection of a fracture, place it on the cast now (Fig 6).
9. Cover the donut pad with silicone.
10. Cover this silicone with just enough gauze to hold the donut pad in place.

11. Apply a gauze pad (large enough to cover the pad) over the donut pad.
12. Apply a layer of silicone over the gauze pad and smooth it out (Fig 7).
13. Cover all the silicone with another layer of roll gauze.
14. Apply another layer of silicone over the roll gauze and smooth it out.
15. Apply additional layers of roll gauze and silicone here.
(if needed). The more severe the injury (or if more protection is needed), the more additional layers are needed.

16. Cut and turn down approximately 1-1/2 inch of each end of the stockinette and roll it over the end of cast (Fig 8).

17. Apply a layer of silicone over the stockinette ends to finish (Figs 9 and 10).

18. Allow time for the outside layer to dry to the touch (approximately 45 minutes) and cut off on unaffected side (Figs 11 and 12).

19. Tape the cast together and set it in a well-vented area to finish drying for approximately 24 hours (Fig 13).

20. The cast can be secured to the injured body part with tape. If necessary, the body part can be taped before applying the cast for additional support.

Note: Approximate casting time is 15 to 20 minutes.

**PRECAUTIONS**

- Apply 100% silicone rubber caulking in a well-vented area.
- Do not let silicone dry between coats.
- Do not let silicone touch the skin.
- Do not leave silicone cast on for an extended period of time while curing; burning of the skin can occur. As soon as the surface is dry to the touch, remove the cast. Exact time varies.
- Fair-skinned athletes may need an extra layer of tape for protection from the heat produced as the silicone dries/cures.
- The person applying the silicone rubber may want to wear latex gloves for hand protection during the procedure.
Silicone casts have been successfully used for a variety of athletic injuries. This method allows for excellent support and protection of all injuries while saving money and eliminating waste. The use of a soft playing cast during competition is allowed according to the NCAA and NAIA. In each case, the athlete wearing the cast must have the cast checked before warm-up by the game officials. At the high school level, different states may have different rules or regulations on soft playing casts. Contact the state’s athletic governing body for any questions on their rules and regulations. In some instances, additional padding may be required.

REFERENCES

Teacher Certification Among Athletic Training Students

Neil Curtis, EdD, ATC

ABSTRACT: Researchers have reported that athletic training students who earn teacher certification enhance their job marketability. The purpose of this study was to determine the number of athletic training students who pursue teacher certification. A survey was mailed to the directors of the 78 NATA undergraduate programs in 1992. Data from the returned surveys showed that 177 of the 703 expected graduates in 1992 and 148 of the 640 graduates in 1991 pursued teacher certification. The most common teacher certification subject area was Physical Education, followed by Health, and Science or Biology. These students should expect to take an additional 1.6 semesters (range 0 to 4) to complete teacher certification requirements. Program directors cited increased job opportunities as the main advantage, and increased time in school and financial burden as the main disadvantages of pursuing teacher certification. Although the potential for high school jobs seems enormous, there is little indication that high schools are increasingly hiring athletic trainers. Formal counseling and advising for athletic training students regarding teacher certification and job opportunities should occur in the first year of study. Additional research should assess the job market.

Athletic trainers are often in the position to advise student athletic trainers on a variety of topics, including how best to prepare for the job market. On numerous occasions, I have encountered upperclassmen and former students requesting information and advice on the merits of pursuing teacher certification. The students often display regret that they had not completed these requirements earlier in their undergraduate education. Various authors report that high school administrators prefer certified athletic trainers with teaching credentials in math, science, and physical education.11,14 Recently, the NATA stated that employment on the high school level is the key to the future for athletic training.6

The goal of this study was to provide information on the pursuit of teacher certification by athletic training students in approved curriculums. This information should assist athletic training educators and students in making decisions regarding educational preparation. The specific purposes were to:

1. Determine the number of students enrolled in NATA-approved undergraduate programs who pursue teacher certification.
2. Identify teacher certification subject areas pursued.
3. Determine the number of additional semesters in school needed to complete teacher certification requirements.
4. Solicit the program directors’ perceptions of the advantages and disadvantages of pursuing teacher certification.

METHODS

A questionnaire was mailed to the directors of the 78 NATA undergraduate programs in the Spring of 1992. The survey was designed to objectively obtain information on the number of students seeking or gaining teacher certification, the discipline in which they were seeking teacher certification, and the additional length of time necessary to complete the requirements. The survey concluded with two open-ended questions seeking the program directors’ perceptions of the advantages and disadvantages for athletic training students pursuing teacher certification.

Each program director received a mailing containing a cover letter describing the purpose of the study, a survey instrument, and a prepaid self-addressed return envelope. After 21 days, a follow-up letter and survey were mailed to those not responding to the initial mailing. Descriptive statistics were computed using standard spreadsheet software. The open-ended questions were compiled and analyzed by hand using standard qualitative procedures to categorize the program directors’ comments.

RESULTS

A total of 72 questionnaires (92%) were returned. Program directors identified 387 of the 1966 students currently enrolled in NATA undergraduate programs (20%) as seeking teacher certification. Of the 703 students graduating in 1992, 177 (25%) pursued teacher certification. Of the 640 students graduating in 1991, 148 (23%) pursued teacher certification. Table 1 shows the teacher certification subject areas of the classes of 1991 and 1992.

The remaining results are based on questions regarding the 1343 students in the classes of 1991 and 1992. Programs varied greatly in the number of athletic training students (range 4 to 40, x = 18.7), the number of these students seeking teacher certification (range 0 to 22, x = 4.5), and the percentage of students seeking teacher certification (range 0% to 100%, x = 21%). Nine program directors (12.5%) reported that none of the athletic training students in the classes of 1991 and 1992 pursued teacher certification. One program (1.4%) reported that all students (100%) pursued teacher certification. Program directors indicated that the following percentages of athletic training students sought teacher certification: 0% to 24% = 40 programs (5.5%), 25% to 49% = 22 (30.5%), 50% to 74% = 5 (7%), and 75% to 100% = 5 (7%). Athletic training students

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Additional time required to complete teacher certification *(three programs did not respond to this question).

**Table 1. Subject Areas of Athletic Training Students Pursuing Teacher Certification in 1991 and 1992**

<table>
<thead>
<tr>
<th>Subject</th>
<th>% of All Students</th>
<th>% of Teacher Certification Students</th>
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<tbody>
<tr>
<td>Physical Ed (PE)</td>
<td>206</td>
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<tr>
<td>Health</td>
<td>48</td>
<td>3.6</td>
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<td>Science or Biology</td>
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<tr>
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<td>43</td>
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</table>

*All PE and Bio students were from one institution.

should expect to take an additional 1.6 semesters (range 0 to 4 semesters) to complete teacher certification requirements (see Figure).

Fifty-four of the athletic training programs (75%) were offered through the Departments of Physical Education (n = 48) or Kinesiology (n = 6); however, no programs required students to complete teacher certification. The program directors’ perceptions of the advantages and disadvantages for athletic training students pursuing teacher certification are presented in Tables 2 and 3, respectively.

**DISCUSSION**

Athletic training curriculums evolved from physical education programs. The 1959 NATA-approved curriculum required physical education teacher certification. By 1970, the NATA curriculum guidelines no longer required teacher certification, but most of the courses required were traditional physical education courses such as exercise physiology, history, organization and administration of physical education, and 9 credits on coaching. In 1983, and again in 1988, the NATA Professional Education Committee guidelines stated that programs should be designed to prepare qualified athletic trainers and teacher-trainers, strongly recommending the completion of a secondary teaching credential. Current CAAHEP guidelines make no direct reference to teacher certification. Beginning with the 1980 NATA resolution requiring approved athletic training programs to become academic majors or major-equivalent (to be fully implemented by 1990), athletic training students were less likely to pursue teacher certification. In a program as majors or major-equivalents, students were required to complete an increased number of credits in athletic training subject matter and therefore increased the total number of credits and time to complete a teaching credential. Kauth presented a roundtable discussion that addressed the concern that the curricular changes may preclude students from gaining teacher certification.

High schools offer the possibility of between 10,000 and 20,000 jobs for graduates of athletic training programs. One 1994 study and two studies from the mid 1980s reported that high school administrators prefer certified athletic trainers with teaching credentials in math, science, or physical education. There is little debate that earning a teaching credential makes one more desirable for most high school athletic training positions. A 1994 survey of secondary school athletic trainers reported that 81% of the responding certified athletic trainers working exclusively in a high school had teacher certification, compared to 34% of certified athletic trainers working in a clinic/high school. A review of the most recent NATA placement vacancy notices showed that there are school districts across the nation searching for athletic trainers with teacher certification.

Earning teaching credentials does not necessarily make one a more competent athletic trainer. A 1986 study reported that 67% of undergraduate program directors and 54% of department chairpersons preferred not to require athletic training.

---

**Table 2. Program Directors’ Response to the Question: What Do You Feel Are the Advantages for Undergraduate Athletic Training Students in Pursuing Teacher Certification?**

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of Program Directors Listing This</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased job marketability/opportunities</td>
<td>60</td>
</tr>
<tr>
<td>Improved teaching/communication skills</td>
<td>15</td>
</tr>
<tr>
<td>Increased pay/job security/conditions</td>
<td>12</td>
</tr>
</tbody>
</table>

**Table 3. Program Directors’ Response to the Question: What Do You Feel Are the Disadvantages for Undergraduate Athletic Training Students in Pursuing Teacher Certification?**

<table>
<thead>
<tr>
<th>Category</th>
<th>Program Directors Listing This</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased time in college/financial burden</td>
<td>46</td>
</tr>
<tr>
<td>Decrease in high school jobs/increase in clinic jobs</td>
<td>14</td>
</tr>
<tr>
<td>TC requirements too restrictive for AT students to complete</td>
<td>11</td>
</tr>
<tr>
<td>Philosophically disagree with preparing students to work two full-time jobs</td>
<td>7</td>
</tr>
<tr>
<td>Others</td>
<td>6</td>
</tr>
</tbody>
</table>
students to earn a teaching certificate. High schools are hiring athletic trainers without teaching certificates.\textsuperscript{10,12} At the college and professional level and in the sports medicine clinics, teacher certification is generally not expected. Although the potential for high school jobs seems enormous, and high school administrators prefer athletic trainers with teaching credentials, there is little evidence to indicate that a momentous hiring initiative will occur. There are approximately 23,000 high schools in the United States. According to the NATA, 2,157 certified athletic trainers were employed directly by high schools in July 1995, a 15% increase from the 1,828 reported in February 1993. Another 2,382 certified athletic trainers provide services to high schools through contracts with sports medicine clinics. In 1994, Sexton et al\textsuperscript{14} reported that only 9% of responding midwestern high school administrators found it financially feasible to hire an athletic trainer. Placement statistics of those students completing undergraduate approved programs in 1994 showed that 168 of the 312 graduates accepting athletic training jobs (54%) did so at a clinic, 54 at a high school (17%), and 46 at a college (15%).\textsuperscript{5} These percentages have been similar for the last 4 years.

Whether or not to pursue teacher certification is ultimately the student’s decision. As educators, mentors, and advisors, we must be knowledgeable about the current and future athletic training employment opportunities. As Prentice and Mishler\textsuperscript{11} asked in 1986, “Are our athletic training education programs … preparing students for the type of employment opportunities that will most likely exist following graduation?” To answer this, further research is needed to assess the job market at the high school and at the clinic level. When, if ever, will more high schools begin to hire full-time athletic trainers or teacher/athletic trainers? What more can we do as a profession to foster this? Will sports medicine clinics continue to be the place of employment for the largest percentage of entry-level athletic trainers? Will the clinics continue to provide athletic training services to high schools at an increasing rate? How long do entry-level athletic trainers remain in these clinic jobs and what do they do when they leave?

Formal counseling and advising for athletic training students regarding teacher certification and job opportunities should occur in the first year of study. At this time, students with an interest in high school athletic training should be encouraged to gain teacher certification. As reported in this study, physical education continues to be the most popular teacher certification subject area. This is likely due to the close relationship many athletic training programs have with physical education programs and the similar coursework in areas such as anatomy, physiology, and exercise science. As suggested by other authors,\textsuperscript{1,11,14} athletic trainers may be more marketable with teacher certification in other areas, such as science and math. Students who expect to pursue opportunities where a teaching credential is not required need to weigh the advantages and disadvantages of earning a teaching certificate while they are still undergraduates. The advantages are the availability and access of the appropriate courses, and the greater potential for job mobility in the future. The disadvantages are an extended and more costly undergraduate career, and possible lack of interest in teacher preparation requirements.

REFERENCES

Refocusing the Adolescent Preparticipation Physical Evaluation Toward Preventive Health Care

Michael C. Koester, ATC

ABSTRACT: The traditional preparticipation physical evaluation has come under much scrutiny by sports medicine physicians in recent years, following a number of studies that have found it to be of low yield and not cost effective. There is a general consensus among these researchers that a refocused preparticipation physical evaluation presents an excellent opportunity for health education. In this article, I review recent research that shows that the traditional “head-to-toe” physical exam is unnecessary and is more effectively replaced by a detailed history and focused physical exam. I present current epidemiologic and sociologic data that is pertinent to all health care professionals working with adolescents. Various methods to uncover potential problem areas in the young athletes’ lives are also discussed. Each format may be adapted to local or community standards and needs. The approach to the preparticipation physical evaluation presented in the article allows athletic trainers to have an active role in the most important aspect of health care: the prevention of disease and injury.

For many years, the preparticipation physical evaluation (PPE) for junior high and high school athletes has been considered a necessary evil by the athletes, parents, coaches, athletic trainers, and physicians involved. The following scenario often ensues: young athletes arrive at the school with a consent slip signed by a parent or guardian, along with a hastily completed medical history form. Following the submission of a urine sample, blood pressure check, and height and weight measurements, the youngsters are marched into the locker room for a mass screening of heart and lung sounds. Boys are often checked for hernias, and perhaps a quick orthopedic exam is performed.

The scenario described above, or variations of it, transpires every summer across the country. However, due to an increasing focus on preventive health care, many professionals in the sports medicine community are calling for the annual PPE to be used as more than just a screening process for physical abnormalities.6,7 The PPE is often the only direct contact a healthy adolescent will have with a physician during the course of the year.15 In addition to the physical assessment, it offers an excellent opportunity to assess adolescents for several risk factors and to discuss many health-related issues.

PURPOSE OF THE PPE

Numerous articles recently published in medical journals concern the efficacy, sensitivity, and cost-effectiveness of the PPE. As mentioned above, several of these articles have focused on the need for preventive education. Athletic training literature has recently shed light upon the role of the athletic trainer in health promotion and disease prevention; however, I found only two articles over the past decade discussing the PPE.1,16 This is surprising because the athletic training staff often plays an important role in the design and organization of the PPE, in conjunction with the team physician and school administrators.

This article has several purposes: first, to provide the athletic trainer with a framework and the background knowledge to assist the team physician in the organization and administration of a focused PPE, which includes preventive health care. In addition, I will provide information on several subjects with which health care workers involved with adolescents on a daily basis should be familiar. I also intend this article to provide a stimulus for athletic trainers, particularly those who work with adolescents, to seek further education, either formally or self-directed, in many of the areas covered. Armed with the proper knowledge, athletic trainers can have a very positive effect on the lives of young athletes.

The ideas presented in this paper represent one form in which the PPE may be conducted. I realize that local traditions and the preferences of various athletic trainers, coaches, administrators, and team physicians may vary a great deal. Therefore, the proposed PPE may be accepted in full, or tailored extensively, to provide the best health care possible to young athletes. Many of the subjects covered in this article are also discussed in the educational monograph, Preparticipation Physical Evaluation, a publication endorsed by the American Academy of Family Physicians, American Academy of Pediatrics, American Medical Society for Sports Medicine, American Orthopedic Society for Sports Medicine, and American Osteopathic Academy of Sports Medicine. The monograph includes the history and physical forms from which I adapted Figures 1 and 2 with minimal changes. All athletic trainers should be familiar with the contents of this document. It may be purchased through any of the organizations listed above.

Before continuing, I must first establish the purpose of the PPE. According to McKeag and Hough, at a minimum, the PPE should assess risk factors and detect disease and injury that might create health problems for the patient during physical activity. In the monograph, Lombardo et al22 list the following goals and objectives:
Detect conditions that may limit participation.
Detect conditions that may predispose to injury.
Meet legal and insurance requirements.
Determine general health.
Counsel on health-related issues.
Assess fitness level and performance.

The first three objectives listed are considered to be the primary goals of the PPE. By refocusing the PPE toward prevention and education, conducting a thorough, focused physical examination, and taking an extensive history, all seven goals can be met.

IS THE PPE NECESSARY?
Numerous publications have discussed the effectiveness of the PPE in its current form. The results of several studies led to the conclusion that a complete physical examination of each athlete is neither necessary nor cost-effective. In a study of 1268 adolescents, Linder et al found that 5% of all examined athletes were referred to specialists. Of those requiring referral, a mere 2% were disqualified from activity. The majority of those disqualified likely would have been discovered by conducting a thorough history alone. Risser et al reviewed the PPEs of 763 high school athletes. They concluded that if the actual cost per hour of all health care workers involved was accounted for, the three positive referrals generated came to a total cost of $4537 per significant finding. In addition, of the 16 medical problems identified, 15 could have been discovered by reviewing the medical history.

Is the PPE effective, or could it even be completely abolished? The answer to that question is not simple, because it depends a great deal upon the manner in which the examination is conducted. The literature clearly points to the conclusion that with a thorough history and a focused physical examination, the PPE may uncover medically disqualifying conditions. The literature also leads me to conclude that a broad general physical examination should no longer be considered appropriate in most situations. The PPE educational monograph does suggest a full physical examination of all new athletes, be they incoming freshmen or transfers from other schools. Otherwise, a focused, concise physical examination will suffice for all returning students; however, additional requirements may vary from state to state. The remainder of the PPE may then be directed toward uncovering additional adolescent risk factors and providing preventive health education.

THE PHYSICAL EXAMINATION
As previously discussed, the PPE has been conducted in many forms in a variety of settings. The traditional locker room "mass screening" technique is inappropriate under any circumstances. This method often results in a hurried, chaotic, and noisy scene, as well as a complete lack of privacy for the young athletes. That leaves the station technique, which has been proven quite effective, or individual exams in a physician's office. Although the physician's office provides what I believe to be the ideal setting for health counseling and risk appraisal, cost and time factors make it the rare alternative.

The appropriate timing of the PPE can often be difficult to determine. Performing the exam 6 to 8 weeks before the start of the school year gives those young athletes with positive physical or historical findings ample time to seek follow-up care and rehabilitation. This means performing the exam during summer, however, a time when many families are vacationing and athletes are difficult to contact. An alternative used by many schools is to schedule the PPE at the end of the school year. This is logistically easier and provides a great deal of time for referral and rehabilitation. As an additional bonus, the late spring PPE fulfills the requirements for those athletes planning to attend summer sports camps.

As discussed above, an accurate history is the most vital aspect of the PPE to ascertain an athlete's risk of physical injury. A comprehensive health history form (Fig 1), completed by the athlete and parent before the PPE, and then reviewed by the athlete and physician, may identify those at risk. Following the history review, the physician may then focus the physical examination toward any potential problems uncovered. Not surprisingly, it has been found that previous injuries or surgeries pertinent to a particular area of the body are strongly associated with subsequent injuries to that area the following season. If deemed appropriate, the athletes may then be referred to specialists or physical therapists for further evaluation.

Some physicians may choose to include a brief orthopedic examination of all athletes, or a sports-specific orthopedic examination (ie, examine shoulders of swimmers and baseball players, knees and ankles of football players). Research regarding the sensitivity and specificity of sports-specific examinations has not been conducted. In addition, Tanner staging (assessment of physical development/sexual maturation) may also be included as part of the physical examination; however, its importance in athletics is not fully known. Each topic is fertile ground for breakthrough research.

Routine checks of height, weight, and blood pressure should always be conducted, as they provide good data for yearly comparison. Routine vision screening is also inexpensive and appropriate. Due to the high incidence of hypertension in our society, blood pressure checks provide a quick and inexpensive means of identifying athletes who may be at risk for developing hypertension. A diagnosis of hypertension should not be made, though, until the readings are found to be high on three separate occasions (Table I). Despite the objections of some, routine laboratory tests such as urinalysis and complete blood count (CBC) are not recommended unless indicated by history or physical exam.

SCREENING FOR CARDIAC ANOMALIES
Always an important component of the PPE, the cardiac exam has become even more prominent in light of the recent high profile tragedies involving the basketball players Hank Gathers and Reggie Lewis. Despite the attention these well-publicized cases received, the risk of sudden cardiac death is incredibly low. Ades states that the risk of sudden death is so
### Preparticipation Physical Evaluation

**History**

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have you ever been hospitalized?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you ever had surgery?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are you presently taking any medications or pills?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you have any allergies (medicine, bees, or other stinging insects)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you ever passed out during or after exercise?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you ever been dizzy during or after exercise?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you ever had chest pain during or after exercise?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you tire more quickly than your friends during exercise?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you ever had high blood pressure?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you ever been told that you had a heart murmur?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you ever had racing of your heart or skipped heartbeats?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has anyone in your family died of heart problems or a sudden death before age 50?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you have any skin problems (itching, rashes, acne)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you ever had a head injury?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you ever been knocked out or unconscious?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you ever had a seizure?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you ever had stinger, burner, or pinched nerve?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you ever had heat or muscle cramps?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you ever been dizzy or passed out in the heat?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you have trouble breathing or do you cough after your activity?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you use any special equipment (pads, braces, neck rolls, mouth guard, eye guards, etc.)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you had any problems with your eyes or vision?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you wear glasses, contacts, or protective eye wear?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you ever sprained/strained, dislocated, fractured, broken, or had repeated swelling, or other injuries of any bones or joints?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoulder</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thigh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neck</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knee</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chest</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forearm</td>
<td></td>
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</tr>
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<td>Shin/Calf</td>
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</tr>
<tr>
<td>Back</td>
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<td></td>
</tr>
<tr>
<td>Wrist</td>
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<td>Hand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you had any other medical problems (infectious mononucleosis, diabetes, etc.)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you had a medical problem or injury since your last evaluation?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When was your last tetanus shot?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When was your last measles immunization?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When was your last menstrual period?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When was your first menstrual period?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What was the longest time between your periods last year?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Explain "Yes" answers

---

I hereby state that to the best of my knowledge, my answers to the above questions are correct.

Date___________________

Signature of athlete ___________________ Signature of parent ___________

---

**Fig 1. The recommended PPE history form.** (Adapted from Lombardo et al. Preparticipation Physical Evaluation (monograph). Kansas City, MO: American Academy of Family Physicians, American Academy of Pediatrics, American Medical Society for Sports Medicine, American Orthopaedic Society for Sports Medicine, American Osteopathic Academy of Sports Medicine, 1992.)
**Preparticipation Physical Evaluation**

### Physical Examination

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<thead>
<tr>
<th>Name</th>
<th>Height</th>
<th>Weight</th>
<th>BP</th>
<th>Pulse</th>
<th>Date of birth</th>
</tr>
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<tbody>
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<table>
<thead>
<tr>
<th>Vision</th>
<th>Corrected</th>
<th>Pupils</th>
<th>Normal</th>
<th>Abnormal findings</th>
<th>Initials</th>
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<tbody>
<tr>
<td>R 20/</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L 20/</td>
<td></td>
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<table>
<thead>
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<th>Initials</th>
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<tbody>
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</tr>
<tr>
<td>Pulses</td>
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</tr>
<tr>
<td>Lungs</td>
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<table>
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<tr>
<th>Tanner Stage</th>
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<th>Abdominal</th>
<th>Genitalia</th>
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<tbody>
<tr>
<td>1</td>
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<td></td>
<td></td>
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<tr>
<td>2</td>
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<td>3</td>
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<tr>
<td>5</td>
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<table>
<thead>
<tr>
<th>Musculoskeletal</th>
<th>Abnormal findings</th>
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<tbody>
<tr>
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<tr>
<td>Shoulder</td>
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<td>Foot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Clearance:**

A. Cleared

B. Cleared after completing evaluation/rehabilitation for: ____________________________________________

C. Not cleared for:

- ☐ Collision
- ☐ Contact
- ☐ Non contact
- Strenuous
- Moderately strenuous
- Non strenuous

Due to: ____________________________________________

**Recommendation:** ____________________________________________

---

**HEADS**

Name of team physician __________________________ Date ___________

Address __________________________ Phone ________

Signature of physician __________________________

---

*Fig 2. The recommended PPE physical examination form. (Adapted from Lombardo et al.22 See Figure 1 for credit.)*
Table 1. The 90th Percentile of Adolescent Blood Pressures

<table>
<thead>
<tr>
<th></th>
<th>Girls (age)</th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
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<td>16</td>
<td>17</td>
<td>18</td>
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<tr>
<td>Systolic</td>
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<td>125</td>
<td>126</td>
<td>127</td>
<td>127</td>
<td>127</td>
<td></td>
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<tr>
<td>Diastolic</td>
<td>78</td>
<td>81</td>
<td>82</td>
<td>81</td>
<td>80</td>
<td>80</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Boys (age)</th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
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<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Systolic</td>
<td>124</td>
<td>126</td>
<td>129</td>
<td>131</td>
<td>134</td>
<td>136</td>
<td></td>
</tr>
<tr>
<td>Diastolic</td>
<td>77</td>
<td>78</td>
<td>79</td>
<td>81</td>
<td>83</td>
<td>84</td>
<td></td>
</tr>
</tbody>
</table>

miniscule that even if the perfect screening method existed, it is likely that 200,000 athletes would have to be examined to determine the one who may die during competition. A thorough history is most likely to identify the major risk factors. Findings indicating the necessity of a further work-up include: 1) syncope, especially when it occurs during exercise; and 2) a family history of nontraumatic sudden death or myocardial infarction in parents, siblings, aunts, uncles, or grandparents under age 50. Both of these areas are addressed by the recommended history form (Fig 1).

The focused PPE must also include inspection, palpation, and auscultation of the chest, as well as palpation of the peripheral pulses. Auscultation should focus on the detection of any murmur which cannot be characterized as innocent (Table 2). If the cardiac history or physical examination are at all remarkable, the physician may consider diagnostic testing, or refer the youngster to a cardiologist for further evaluation. The routine use of echocardiography on all athletes is highly discouraged. Not only are these tests unable to detect all potential victims of sudden death, but their use runs the risk of such testing being considered the standard of care for athletes by the legal profession, thus placing all parties at legal risk when not used.

THE NEED FOR PREVENTIVE EDUCATION

Adolescents represent the only age group in the United States with a rising mortality rate. Violence (homicides, suicides, accidents) is the cause of 77% of all deaths for individuals between the ages of 15 and 24. Accidental deaths alone account for 53.5% of violent deaths, and 60% of these accidental deaths involve a motor vehicle. Additionally, one of every ten adolescent girls becomes pregnant annually. It is also estimated that each year one of every six adolescents acquires a sexually transmitted disease. Adolescents also continue to have high rates of drug and alcohol use, as well as poor nutritional habits.

Table 2. Heart Murmurs Requiring Further Work-Up

<table>
<thead>
<tr>
<th>Holosystolic murmurs (all)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous murmurs (nonvenous hum)</td>
</tr>
<tr>
<td>Diastolic murmurs</td>
</tr>
<tr>
<td>Any murmur which softens when the athlete squats or becomes louder when the athlete stands or sits</td>
</tr>
</tbody>
</table>

Considering the aforementioned statistics, it is not surprising that when asked to rate their own health concerns, adolescents ranked "dealing with stress and depression" at, or near, the top. Despite the staggering statistics listed above, on average, patients between the ages of 11 and 20 spend only 11.6 minutes with their physician per visit. Adolescents and young adults are quite willing to be educated, as one study found that 70% of young men and 78% of young women wanted their physicians to present them with information on a variety of health-related topics.

The PPE offers a time during which many problems and risk factors can be uncovered and health education may be disseminated. College athletes have been found to have a significantly higher proportion of "risky" lifestyle behaviors, when compared to nonathletes. Therefore, preventive education is directed at a subgroup of adolescents who may be at an even higher risk in the future than others in their age group.

METHODS OF PREVENTIVE EDUCATION

Identifying youngsters at risk and providing useful, informative, and appropriate health education are difficult goals to achieve. These goals must be reached through the use of both one-to-one interactions and small group discussions and instruction. The methods and personnel used to elicit and teach such information are quite important. Educational goals can be reached through the use of speakers, pamphlets, and short video presentations. Educational stations addressing many of the previously mentioned adolescent health topics can easily be integrated into the station technique. In my experiences, these educational interactions have been very successful, and well appreciated by the young athletes and their parents. A variety of presenters may also be used, as long as they are knowledgeable in their area and able to answer a wide array of questions. Presentations should be short, entertaining, and attuned to the concrete thinking of most adolescents. There is much room for creativity; however, the age group and the wishes of parents and the local school board must be respected concerning the subjects of adolescent drug use and sexuality.

Identifying possible risk factors should be considered just as important as identifying physical limitations. The most difficult organizational aspect of this portion of the PPE is finding properly trained personnel. It must be kept in mind, though, that this is a screening process, and adolescents in need of counseling can be referred. As a young athlete with physical findings of anterior cruciate ligament rupture would be referred to the orthopedic surgeon, the youngster who reports suicidal ideation must be referred to a physician or psychologist. Therefore, conducting this portion of the exam is not restricted to physicians only. However, the personnel employed should have familiarity with the various aspects of adolescent medicine and professional respect for privacy rights.

This approach to the PPE is relatively new. Accordingly, there is little data to support how screening can be accomplished most effectively. I propose two separate methods. The first involves the use of questionnaires (Figs 3 & 4). This format has been found to significantly increase the implementation of adolescent preventive health care by physicians.
Girl's Confidential Health Questionnaire

Age ___________ School _________________________

Please answer the following questions as best as you can.

1. How old were you when you had your first menstrual period? ____________________________
2. How often do you have your period? ______________________________
3. How long does your period usually last? ______________________________
4. When was your last period? ________________________________
5. Do you ever have trouble with heavy bleeding? ______________________________
6. Do you have any questions about tampon use? ______________________________
7. Do you experience cramps during your period? _______________ How do you treat them? ______________________________
8. Do you take birth control pills or hormones? ________________________________
9. Are you sexually active? ______________________________
10. If you are sexually active, does your partner use a condom? ______________________________
11. Do you have any questions about other birth control methods or devices? ______________________________
12. Are you aware of the risk factors for getting HIV or other sexually transmitted diseases (STDs)? ______________
13. Are you aware of the effects of an STD infection? ______________________________
14. Have you ever had an unusual discharge from your vagina? ______________________________
15. When was your last pelvic exam? ______________________________
16. Have you ever had an abnormal Pap result? ______________________________
17. Have you ever had a bladder or kidney infection? ______________________________
18. How many meals do you eat each day? ________________ Snacks? ____________________________
19. List what you have eaten over the last 24 hours: ______________________________________
20. Are there any foods you refuse to eat, like meat or spinach? ______________________________
21. Have you ever been on a diet? ______________________________
22. Are you happy with your weight? ________________ If not, how much do you want to weigh? ______________
23. Have you ever tried to control your weight by vomiting? ________________________________
    Using diet pills? ________________ Laxatives? ________________ Diuretics? ________________
24. Have you ever been diagnosed as having an eating disorder? ________________________________
25. Do you have any questions about healthy ways to control your weight? ________________________________
26. Do you always wear your seatbelt when riding in a car? ______________________________
27. Do you always wear a helmet when you bike, rollerblade, or skateboard? ______________________________
28. Do you smoke? ______________________________
29. Do you drink alcohol? ______________________________
30. Do any family members drink alcohol? ______________________________
31. Do you use other drugs or inhalants? ______________________________


Because they are quite detailed, these questionnaires may be most appropriate for use in the office setting, where the younger could complete the form before seeing the physician. In addition, many of the questions may be considered inappropriate by parents and administrators. The questionnaires may be modified and used to guide discussions rather than be completed by the athlete, which would also avoid potential patient confidentiality conflicts.

Adolescent problems may also be identified by asking several specific questions about important areas of their lives. These areas can be combined to form several easily remembered pneumonics. I prefer to use the “HEADS” questions. Areas of conversation and direct questions are listed in Tables 3 and 4. The topics in Table 3 are those I ask of the majority of adolescents; however, for younger teens, the topics listed in Table 4 may be considered more appropriate. Again, changes
Boy’s Confidential Health Questionnaire

Please answer the following questions as best as you can.

1. Are you sexually active? ___________________________
2. If you are sexually active, do you use a condom? ___________________________
3. Do you have any questions about other birth control methods or devices? ________
4. Are you aware of the risk factors for getting HIV or other sexually transmitted diseases (STDs)? ________
5. Are you aware of the effects of an STD infection? ________
6. Have you ever had an unusual discharge from your penis? ________
7. How many meals do you eat each day? ___________ Snacks? ________
8. List what you have eaten over the last 24 hours:

9. Are there any foods you refuse to eat, like meat or spinach? ________
10. Have you ever been on a diet? ________
11. Are you happy with your weight? ___________ If not, how much do you want to weigh? ________
12. Have you ever tried to control your weight by vomiting? ________
   Using diet pills? ___________ Laxatives? ________ Diuretics? ________
13. Have you ever been diagnosed as having an eating disorder? ________
14. Do you have any questions about healthy ways to control your weight? ________
15. Do you always wear your seatbelt when riding in a car? ________
16. Do you always wear a helmet when you bike, rollerblade, or skateboard? ________
17. Do you smoke? __________________________________
18. Do you use smokeless tobacco or snuff? ________
19. Do you drink alcohol? ________
20. Do any family members drink alcohol? ________
21. Do you use other drugs or inhalants? ________

Fig 4. Confidential Health Questionnaire for the male athlete. (Adapted from Johnson MD. 18 See Figure 3 for credit).

Table 3. HEADS Topics and Sample Questions for the Mature Adolescent

| Home life: problems with parents or siblings, living arrangements, parents’ drug use? |
| Education: grade level, grades, enjoy school, future plans? |
| Activities: what do you do for fun, extracurricular activities, who are your friends, what are weekends like? |
| Drugs: do you or your friends drink alcohol, how much, how often, do you drink until you are drunk, use marijuana, cocaine, inhalants, other drugs? |
| Sex: are you sexually active, use birth control, condoms, sexual preference, number of partners, do you know about risks (pregnancy, STDs, HIV)? |
| Suicide: have you ever been depressed, do you feel like you are under too much pressure, thought of or attempted suicide? |

Table 4. HEADS Topics and Sample Questions for the Younger Adolescent

| Home life: problems with siblings or parents, living arrangements, adequate diet? |
| Education: grade level, grades, enjoy school, future plans? |
| Activities: what do you do for fun, extracurricular activities, who are your friends, what are weekends like? |
| Depression: ever stressed out or depressed, how do you handle it? |
| Safety: seat belts, helmets, guns in the house or at friend’s house? |

PRACTICAL ASPECTS OF THE REFOCUSED PPE

Each sports medicine staff that chooses to conduct PPEs in this manner will be doing it for the first time, and in their own way. Hence, it is difficult to estimate the total time commitment and number of physicians and support personnel required. Time estimates for each component are provided below. As for the flow of athletes, educational and health screening stations should be concentrated at the end of each athlete’s evaluation to avoid major delays, since by their very nature these will be more prone to running overtime. In addition, arrival times should be staggered for larger groups, to avoid overcrowding.
Though it will vary somewhat with the problems encountered, the history review and focused physical exam should rarely take more than 5 to 10 minutes per participant. Appropriately trained primary care physicians (internists, family physicians, pediatricians) are more than adequately qualified to perform all facets of the history review and physical evaluation. Also, if well trained and experienced, it is certainly appropriate for certified athletic trainers and physical therapists to conduct the musculoskeletal evaluation. As a bonus, the organizer of the PPE may obtain the services of cardiologists and orthopedic surgeons, but this should not be considered a necessity. Four to six physicians should be adequate in most situations. A large number of physicians may be difficult to attain, but it is possible with a certain amount of long-range planning.

For the remainder of the PPE, an additional 5 to 10 minutes will be required to have blood pressure checked, measurements taken, and vision tested at separate stations. The same amount of time should also be allotted for the one-to-one health screening. If one or two short presentations on specific areas of prevention are included for each group, individual athletes should expect the entire process to take about 45 minutes. However, as previously stated, this is likely to vary the first time a staff implements this format.

I admit that all health concerns cannot be addressed in such a short time frame; however, many subjects can be covered. Innovation is the most important concept for the organizing athletic trainer to keep in mind. Educational topics may be rotated on a yearly basis. Boys and girls may be separated for specific discussions. One-to-one screening can also be tailored to the needs of a specific age group or school. The PPE may also serve as an opportunity to distribute and discuss pamphlets regarding self-breast and self-testicular examinations and related topics. In addition, although this article is largely focused toward the education of junior high and high school athletes, this approach to the PPE would be feasible at the college, and perhaps even at the professional level.

The annual PPE can also serve to raise funds for the athletic training department. Many schools charge each individual athlete $10 to $15 for the exam, if he or she can afford the amount. If the services of the physicians and support staff are donated to the school, the athletic trainer may be left with several thousand dollars to put toward new equipment, supplies, and educational materials from which the athletes may benefit. In addition, such funds may also be put toward athletic equipment for needy students.

CONCLUSIONS

The PPE represents an excellent and exciting opportunity for adolescent preventive health screening and education. Studies have shown that the mass physical screening of all athletes is neither an efficient nor cost-effective means of uncovering disqualifying conditions. In addition, the PPE is often performed more for the purpose of limiting legal liabilities than the medical health and safety of adolescents. The refocused PPE allows athletic trainers to expand their traditional role of injury prevention as well as enter into the forefront of health promotion and disease prevention. As the face of health care continues to change across the nation, the PPE conducted in this manner focuses a bright light on the role athletic trainers can play in health education. No other allied health care profession in the United States is similarly situated.

Unfortunately, the problems of adolescence and the troubles of society cannot be solved by the PPE. Bearing this in mind, the preventive health screening and education discussed in this article will have at least some impact among those counseled. Admittedly, the encounter is a brief one with numerous topics left undiscussed. It does provide a starting point, though. With the suggestions and changes presented, the PPE can become the valuable health education interaction it should be, rather than the assembly-line farce to which it often evolves.

ACKNOWLEDGMENTS

I would like to thank Jerry Koloskie, MS, ATC, George Hess, MD, and Ken Misch, MD, for their direct and indirect contributions to this paper. I would also like to thank Luz Engelbrecht at Northeastern Rural Health Clinics in Susanville, CA for her assistance in developing the health questionnaires.

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Septic Arthritis in a Collegiate Football Player

James A. Madaleno, MS, ATC; Jeffrey R. Allen, MEd, ATC; Kurt E. Jacobson, MD

ABSTRACT: A 23-year-old collegiate football player reported to the training room the day after a game, complaining of severe pain in his right shoulder. He recalled no significant injury during the game. Physical examination revealed pain, tenderness, and apprehension with all attempts to palpate or move the joint. There was no obvious effusion, redness, or warmth about the shoulder joint. The neurovascular examination was negative, and x-rays revealed no fracture. The patient’s temperature was 102°F. The team orthopedist aspirated 10cc of purulent fluid from the joint. Subsequent analysis revealed a white cell count greater than 50,000 mm³, but no organisms were seen. The diagnosis of septic arthritis was made on the basis of the elevated cell count of the joint aspirate, in conjunction with fever (102°F) and the clinical findings of an excessively painful joint. The patient was admitted for arthroscopic irrigation and debridement of the joint. Cultures subsequently showed a light growth of a Gram-negative organism. The patient was treated initially with intravenous broad-spectrum antibiotics and was ultimately discharged and put on oral antibiotics at the time of discharge. Rehabilitation followed the usual protocol for diagnostic arthroscopy, and the patient made an excellent recovery. He has had no residual sequelae or recurrence of infection.

CASE HISTORY

The day after a game, a 23-year-old white football player reported to the training room complaining of extreme right shoulder pain. This starting defensive lineman could not recall sustaining an injury during the game, but he had tightness and dull aching in his shoulder 2 to 3 hours after the game. Past medical history concerning his shoulder was negative. No obvious abnormalities, warmth, or effusion were noted upon examination of the joint, but the athlete displayed significant apprehension to the examiner’s attempts to palpate the affected shoulder. By palpation of bony landmarks, it was determined that the shoulder was not dislocated. Any motion of the shoulder was accompanied by severe pain and resultant muscle spasm and guarding. Instability testing could not be performed because of the level of discomfort. Neurovascular examination showed no evidence of arterial or venous obstruction or any signs of neurologic injury. Radiographs were read as negative for both the glenohumeral joint and the scapula. The patient’s only other symptoms were throat irritation and pain with swallowing.

The patient was referred to the team physician for evaluation. At that time, because of the severe pain the athlete was experiencing and the presence of fever (102°F), the physician suspected septic arthritis. Joint fluid analysis revealed an elevated white blood cell (WBC) count (greater than 50,000). The complete blood cell count showed slight elevation of the white count and the sedimentation rate was minimally elevated (see Table). Gram stain was negative for organisms, and aerobic and anaerobic cultures were done.

The athlete was admitted to the hospital for presumed septic arthritis, and intravenous antibiotics were started immediately. Arthroscopic debridement and irrigation supported the diagnosis of septic arthritis, and culture and sensitivity of the aspirated fluid ultimately grew out a Gram-negative organism. Intravenous antibiotics were continued for the 5-day hospital stay, and the patient’s complete blood cell count and sedimen-
tation rate were monitored daily (see Table). On day 1 of hospitalization, the patient’s WBC count was at its peak, 13,900 mm\(^3\) (normal 4,500 to 11,000 mm\(^3\)). It gradually fell during the course of the hospital stay. The patient’s sedimentation rate was initially 47 mm/h and reached a high of 81 mm/h (normal 0 to 15 mm/h) on day 4. He was discharged when his shoulder pain was decreased and his complete blood cell count began to return to normal. He was placed on oral antibiotics for 2 weeks, and his complete blood cell count was checked weekly for 3 weeks.

Upon his discharge from the hospital, the athlete began a rehabilitation program composed of range-of-motion exercises, strength and endurance training specific for the shoulder complex joints (glenohumeral, scapulohumeral, sternoclavicular, acromioclavicular, and subdeltoid), and an overall cardiovascular conditioning program. Strength and active range of motion quickly returned to normal. Criteria for return to football were: 1) return to normal strength and range of motion, and 2) a normal WBC count and sedimentation rate. The interval from the onset of his symptoms to his return to play was 22 days.

We gave the athlete specific instructions to notify us immediately of any return of symptoms. He had no further problems and he finished the season and participated in winter conditioning and spring practice.

**DISCUSSION**

In our review of the literature on septic arthritis, we found that although authors define specific signs and symptoms associated with the disease, most commented on the difficulty of diagnosis. Delay in beginning treatment is a significant factor leading to poor results. Because this patient’s diagnosis was made within 2 days, the infection did not have an opportunity to damage the joint or capsular structures—a common occurrence in septic arthritis.

Schmid noted that previously traumatized joints are much more susceptible to infection. Other predisposing factors include: rheumatoid arthritis, previous surgery, corticosteroid injection, and compromise of the immune system. Of the two types of bacteria infecting living tissue, Gram-positive bacteria are more prevalent than Gram-negative bacteria in septic arthritis. Gram-positive bacteria include streptococci, which can be found in the oropharynx, and staphylococci, which are commonly found in skin and surface wounds. *Staphylococcus aureus* is the most common cause of septic arthritis.

Laboratory data are very important in the diagnosis of septic arthritis. The most reliable test during the acute phase is joint aspiration, which should be performed under strict aseptic conditions. The aspirated fluid is usually diagnostic, revealing a markedly elevated white blood cell count. A Gram stain is done to identify organisms. The serum white blood cell count may lag behind the joint WBC count during the initial phases of infection. Thus, a normal serum WBC count does not exclude the presence of joint sepsis. Cultures must be done, but because of the 24- to 48-hour delay in reporting the results, treatment must often be based on clinical findings and other laboratory data. Antibiotic treatment may later be adjusted based on the culture and sensitivity results.

An additional useful diagnostic test is the erythrocyte sedimentation rate (ESR). Initially, the sedimentation rate may be normal. There is a delayed rise and subsequent fall in the sedimentation rate as the infection progresses and then resolves. During active infection and even during the convalescent phase, sedimentation rate may be used to monitor the body’s response to the infection and the ongoing need for antibiotic treatment. The patient is usually treated with oral antibiotics until the sedimentation rate returns to normal.

The primary treatment of septic arthritis is aggressive irrigation and debridement of the joint, which can be accomplished either arthroscopically or through an open incision, depending upon the particular clinical features of the case. Repeated needle aspirations are not recommended for large joint sepsis because they fail to adequately irrigate the joint of the destructive bacterial enzymatic components.

This case demonstrates the need for the athletic trainer to consider the diagnosis of septic arthritis in any patient who presents with severe joint pain and extreme apprehension, in the absence of an apparent mechanism of injury.

**REFERENCES**


This paper describes the rehabilitation of a patient following a medial meniscus transplant. Both preoperative and postoperative history and relevant physical findings are presented. Rehabilitation goals and the corresponding treatment plan are discussed, with an emphasis on functional outcomes. A general framework for treatment addressing impairment and functional goals is outlined. Progression of the rehabilitation program was based on surgical precautions and the patient’s tolerance to the exercise progression. This case study demonstrates that appropriate surgical intervention combined with a properly designed rehabilitation program contributed to the improved functional abilities of this patient.

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Rehabilitation following injury or surgery for the athlete who employs overhead motion is extremely challenging. Shoulder pathophysiology and the repetitive intense demands required during athletic activity need to be fully appreciated for successful rehabilitation. This article discussed new anatomic and biomechanical concepts that require the rehabilitation specialist to reconsider previously accepted notions. Treatment rationale is discussed based on these concepts. Rehabilitation principles and phases are described in a sequentially progressive program based on tissue reactivity and signs and symptoms.

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Anterior shoulder dislocation is a common skiing injury. Several methods are available for reduction of shoulder dislocations. We evaluated a method for reduction of anterior shoulder dislocation that has not previously appeared in the literature. This method is performed with the patient seated in a chair with the chair used as countertraction. The physician applies traction to the affected shoulder using downward pressure on a loop of stockinette wrapped around the patient’s forearm. Our method was successful in 97% of 118 anterior dislocations with no complications. Ninety-three percent were performed without the use of narcotic analgesia.

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We sought to determine if knee stability after autogenous bone-patellar tendon-bone anterior cruciate ligament reconstruction was adversely affected by obtaining immediate full hyperextension. We selected patients based on degree of knee hyperextension. Group 1 (46 men and 51 women), with an average of 10° (range, 8° to 15°) hyperextension, was compared with the randomly selected control Group 2 (70 men and 27 women), which had an average of 2° (range, 0° to 5°) hyperextension. The operative knee in both groups, which underwent similar reconstruction of the injured knee, achieved full passive extension equal to the noninvolved knee during the immediate postoperative course. The average KT-1000 arthrometer manual maximum side-to-side differences were 2.4 mm for Group 1 and 2.1 mm for Group 2 (p = .13). Seventy-nine patients in Group 1 had KT-1000 arthrometer differences of ≥ 3 mm as compared with 85 patients in Group 2. Fourteen patients in Group 1 had KT-1000 arthrometer differences of 4 mm or 5 mm as compared with eight patients in Group 2. Four patients in each group had KT-1000 arthrometer differences >5 mm. Evidence suggests that restoring and maintaining immediate full knee hyperextension after this type of reconstruction does not adversely affect the ultimate stability of the knee.

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Twenty-nine knees in 23 patients with symptomatic osteoarthritis underwent washout with lactated Ringer’s solution. Two arthroscopic cannulas were placed into the knee under local anesthetic. Three liters of fluid were run through the knee using varying inflow and outflow to alternately inflate and deflate the knee. We obtained Hospital for Special Surgery knee scores, Knee Society pain and function ratings, and visual analog pain scales before washout and up to 2 years after washout. At 1 year, the mean Hospital for Special Surgery score increased from 72 to 87, the Knee Society pain rating from 64 to 89, and the Knee Society function rating from 62 to 82. Twenty-five knees had a good or excellent result at 1 year. Twenty-one of these were observed at 2 years; 17 had good or excellent results. This study confirms the value of a fluid washout in an arthritic knee for some patients. This may explain some of the symptom relief seen with arthroscopic procedures in this condition.

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Soccer is the most popular team sport worldwide, with approximately 40 million amateur participants. Most fatalities in soccer are related to player impact with the goal post. This study focuses on two case reports, a laboratory testing phase, and a pilot field testing phase of preventive equipment that can be used around the goal to prevent injury. Horizontal and vertical impact testing in the laboratory revealed impact force was diminished when the goal post was covered with protective padding (reduction of 31% and 63%) (p < .05). These data showed a statistically significant decrease in force at all temperatures. In the pilot field testing phase of the study, 471 games were monitored. Soccer teams participating in youth, teen, and adult soccer leagues were included in this phase of the study. During the 3-year study, there were seven player collisions with padded goal posts, and no injuries were recorded. The use of padded goal posts within the game of soccer has been demonstrated to reduce the possibility of injury, both in the laboratory phase and in the pilot field testing phase.

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Stability of the thumb metacarpophalangeal joint is provided by the collateral ligament proper, the accessory collateral ligament, the proximal and distal palmar ligaments, and the palmar plate. The adductor pollicis and flexor pollicis brevis muscles also provide soft tissue support and insert on the proximal phalanx of the thumb by way of the sesamoid bones. Fractures of the metacarpophalangeal joint sesamoid bones are uncommon but are often associated with sporting injuries during which the joint is acutely hyperextended. Routine anteroposterior and lateral radiographs may be unremarkable, and oblique views are often necessary to document the fracture. We report eight cases of fracture of the thumb metacarpophalangeal joint sesamoid. Seven were isolated sesamoid fractures, and one was associated with a metacarpophalangeal joint dislocation. None of the fractures were evident on anteroposterior radiographs, but all were seen in the oblique projection. Six fractures were treated with splint or cast immobilization for 2 to 3 weeks, and two were taped. Clinical follow-up of the seven patients with isolated sesamoid fracture at 6 to 8 weeks revealed pain-free normal function. One patient could not be reached for follow-up.

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Forty-four patients, ranging in age from 17 to 57 years (average, 32), were evaluated an average of 4 years (range, 2 to 9) after surgical reconstruction for Allman-Tossy Grade III acromioclavicular dislocations. Twenty-seven patients underwent repair for acute injuries (<3 weeks after injury) and 17 patients underwent reconstructions for chronic injuries (>3 weeks). Coracoclavicular fixation with heavy nonabsorbable suture was used to correct superior displacement in all cases. In addition, transfer of the coracoclavicular ligament to the distal clavicle was performed in 15 of the 27 early repairs and 17 of the 17 late reconstructions. Overall, 26 of 27 (96%) early repairs and 13 of 17 (77%) late reconstructions achieved satisfactory results. There was a trend for better results and return to sports or heavy labor with early repairs; however, this was not statistically significant (p = .065). When the results of early repairs were compared with those of late reconstructions performed more than 3 months after injury, the results of the shoulders undergoing early repair were significantly better (p < .01). Overall, 39 of 44 (89%) patients achieved a satisfactory result. Surgical reconstruction for acromioclavicular dislocation provides reliable results including use of the arm for sports or repetitive work.

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We describe a new method of evaluating anterior cruciate stability that we call the drop leg Lachman test. This test is performed with the patient supine and the leg to be examined abducted off the side of the table and flexed 25°. The thigh is stabilized to the examining table with one of the examiner's hands, and the patient's foot is held between the examiner's legs. The examiner's free hand provides the anteriorly directed force as done in the Lachman test. A prospective study of 52 patients who were identified as unilaterally anterior cruciate ligament deficient was conducted. Forty-two subjects were tested while conscious, and 40 subjects were tested under anesthesia. Each subject was examined with a KT-1000 arthrometer. In the conscious group, the drop leg Lachman test resulted in 1.8 mm greater average excursion than the Lachman test. In the anesthetized group, the drop leg Lachman test resulted in 2.4 mm more average translation than the Lachman test. In both groups, the difference between tests was statistically significant. The drop leg Lachman test is physically easier to perform than the Lachman test, and it is a sensitive method of demonstrating anterior laxity in an anterior cruciate ligament-deficient knee.

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A computerized hand and wrist motion analysis system was modified to
capture data at a rate of up to 1000 Hz. Using this system, wrist flexion and extension data were collected on five right-handed professional pitchers (75 pitches). A wrist position versus time graph was generated for each pitch. The pitch data produced a reproducible analysis of motion for the majority of the pitches regardless of pitcher. Based on the graphic display of data points, four phases of wrist motion during a pitch were identified. The first phase is the cocking phase, or the motion of the wrist as it moves into maximum extension. This is then followed by the most explosive phase, the acceleration phase, which represents ball propulsion. At ball release, the wrist progresses through flexion and there is a consistent decrease in wrist velocity, known as the deceleration phase. Finally, there is the recovery phase, or the return of the wrist toward neutral. Average values for wrist range of motion, length of phase, and angular velocity (°/s) were calculated for each phase of the pitch. This study represents a major step toward quantifying motion of the wrist during a pitch. The ability to quantify injury and rehabilitation.

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We evaluated the effect of two different anterior capsular shift strategies on load-induced multidirectional glenohumeral motion. Nine cadaveric shoulders were tested on a special test apparatus in which three motions were constrained but which allowed simultaneous measurement of three translations: anteroposterior, mediolateral, and superoinferior. A simulated Bankart lesion was created by detaching the inferior glenohumeral ligament and labrum from the anterior glenoid from 5 mm superior to the anterior band of the inferior glenohumeral ligament to a point just posterior to the infraglenoid tubercle. The two types of medial-based anterior capsular shifts were performed sequentially using fixation via a transglenoid drill hole and No. 2 suture. One shift medialized the anterior capsule on the glenoid by 5 mm; the other one shifted the anterior capsule 5 mm superior on the anterior glenoid. Biomechanical testing was done in two positions of humeral elevation in the scapular plane, three positions of humeral rotation, and with an externally applied joint compression load of 22 N. Glenohumeral motion was measured in the intact state, after creation of the simulated Bankart lesion, and after each of the two anterior capsular shifts. Both the superior and medial shifts of the capsule decreased anterior glenohumeral translation to equivalent extents. For posterior and inferior translation at 45° elevation, the superior shift significantly decreased translation to a greater extent than did the medial shift.

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Elastic bandages are often used to treat musculoskeletal disorders, even though there is little scientific evidence currently to support this generalized practice. We tested the hypothesis that elastic bandages improve proprioception of the bandaged joint during their use, and that this benefit was more than temporary. The uninjured human knee was used as a model. Fifty-four volunteers (54 knees), aged 22 to 40 years, were asked to identify a prior set joint angle as their knee was passively extended. Each knee was tested without the elastic bandage, immediately after bandage application, after 1 hour of bandage wear, and finally after removal of the bandage. Results showed that elastic bandages significantly improved knee joint proprioception in the uninjured knee during the entire interval of their use (mean decrease in inaccuracy of 1.0°, equivalent to 25% improvement, p < .05), and that this benefit was lost when the bandage was removed. The magnitude of the improvement, or the potential beneficial effect of the bandage, was inversely related to the participant’s inherent knee proprioceptive ability, which was demonstrated in the test group before the initial application of the bandage.

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The purpose of this investigation was to establish a database regarding the isokinetic muscular performance characteristics of the abductor and adductor muscles of professional baseball pitchers. Eighty-three healthy professional baseball pitchers (mean age, 22.6 yr; mean weight, 199 lb) were evaluated by use of a Biodex isokinetic dynamometer. Isokinetic tests were performed concentrically at 180° and 300°/s for both the throwing and nonthrowing shoulders. The testing protocol and test repetitions were standardized for each subject. Statistical analysis was performed using a paired t test. Determination of the correlation coefficient was made at the p < .05 level of significance. Test results for bilateral comparisons of mean peak torque for the throwing and nonthrowing shoulders demonstrated a significant difference in adductor values between the dominant and nondominant shoulders at both test speeds. There were no significant differences between extremities for the shoulder abductor muscles. The abductor-to-adductor muscle ratios between the throwing and nonthrowing shoulders were also statistically significant at both test speeds. Throwing arm values were 82.5% at 180°/s and 93.8% at 300°/s compared with only 66.0% and 70.3%, respectively, for the nonthrowing shoulders.

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American Journal of Sports Medicine
To describe the relationship of the pronator teres, flexor carpi radialis, flexor digitorum superficialis, and flexor carpi ulnaris muscles to the medial collateral ligament at 30°, 90°, and 120° of elbow flexion, we dissected 11 cadaveric specimens. The flexor carpi ulnaris muscle is the predominant musculotendinous unit overlying the medial collateral ligament in the majority of cases and is the only one at 120° of elbow flexion. The flexor digitorum superficialis muscle is the only other significant contributor. The medial collateral ligament is the primary stabilizer of the medial elbow with elbow flexion greater than 30°, as in throwing. The flexor carpi ulnaris muscle, because of its position directly over the medial collateral ligament, and the flexor digitorum superficialis muscle, with its near proximity and relatively large bulk, are the specific muscles best suited to provide medial elbow support. This is especially relevant to overhand-throwing athletes who encounter extreme valgus force across the elbow during the cocking and acceleration phases of the throwing motion. Exercise and conditioning of the medial elbow musculature, specifically the flexor digitorum superficialis muscle and the flexor carpi ulnaris muscle, may prevent injury or assist in rehabilitation of medial elbow instability, especially in overhand throwing athletes.

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Elbow and shoulder kinetics for 26 highly skilled, healthy adult pitchers were calculated using high-speed motion analysis. Two critical instances were: 1) shortly before the arm reached maximum external rotation, when 67 Nm of shoulder internal rotation torque and 64 Nm of elbow varus torque were generated, and 2) shortly after ball release, when 1090 N of shoulder compressive force was produced. Inability to generate sufficient elbow varus torque may result in medial tension, lateral compression, or postero-medial impingement injury. At the glenohumeral joint, compressive force, joint laxity, and 380 N of anterior force during arm cocking can lead to anterior glenoid labral tear. Rapid internal rotation in combination with these forces can produce a grinding injury factor on the labrum. After ball release, 400 N of posterior force, 1090 N of compressive force, and 97 Nm of horizontal abduction torque are generated at the shoulder; contribution of rotator cuff muscles in generating these loads may result in cuff tensile failure. Horizontal adduction, internal rotation, and superior translation of the abducted humerus may cause sub-acromial impingement. Tension in the biceps tendon, due to muscle contraction for both elbow flexion torque and shoulder compressive force, may tear the anterosuperior labrum.

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Conservative treatment of acute anterior cruciate ligament injuries was recommended to selected patients, including those with sedentary occupations, low athletic demands, or ages greater than 30 years. Patients with generalized hyperligamentous laxity were excluded. Fifty-five of 61 patients were available at an average follow-up of 46 months from the time of initial injury. At follow-up, giving-way symptoms had not occurred in 23 patients (42%); in 22 (40%), giving way occurred occasionally. Of the 44 patients involved in high- or moderate-demand athletics, 33 (70%) were able to continue with moderate-demand sports. Presence of a medial collateral ligament sprain did not affect the long-term function. Forty-eight percent of the patients scored excellent or good (9 and 18 patients, respectively) on the Hospital for Special Surgery ligament scoring system; 8 (15%) later chose surgical reconstruction. The remaining 47 patients did not believe that their symptoms were severe enough to warrant any further intervention. In a group of individuals who are older and relatively inactive, nonoperative management of anterior cruciate ligament injuries can yield satisfactory results, provided the patients are willing to accept a modest amount of instability and a slight risk of meniscal injury.

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A lateral patellar retinacular release that transects the tendon of the vastus lateralis muscle may result in significant complications. To avoid such complications, the superior extent must be limited, and maximizing the inferior extent may be important in achieving an adequate release. The effective release of the patella from its lateral retinaculum was examined for 2 incision lengths using 10 fresh-frozen human cadaveric knees and comparing the mediolateral displacement of the patella relative to the femur for 3 study groups (control, intact retinacula; Group A, retinacuла cut from the inferior third of the vastus lateralis tendon down to the anterolateral articular portal; and Group B, retinacuла cut from the inferior third of the vastus lateralis tendon down to the tibial tubercle) when a 22-N medially directed force was applied to the patella with the knee at 30° and 60° of flexion. The extended release (Group B) resulted in a significantly more effective release when compared with the standard release (Group A) or control group. This technique may allow an adequate release of the patella while preserving the function of the vastus lateralis muscle.

Thirty adolescents with acute, primary patellar dislocation were assessed for a relationship between articular hypermobility and chondral injury. The 15 patients without articular hypermobility had a 2.5 times increased frequency of articular lesions when compared with 15 patients with hypermobility. Assessment of articular hypermobility should be part of the examination in patients with patellar dislocation.

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The detachment of the superior labrum from anterior to posterior has previously been reported. This lesion has been classified into four types. It was our impression that not all superior labrum abnormalities fit into such a classification system and that the mechanism of injury was distinctly different. During a 5-year period, 84 of 712 (11.8%) patients had significant labral abnormalities; 52 of 84 patients (62%) had lesions that fit within the classification system (Type II, 55%; III 4%; IV, 4%), but 32 of 84 patients (38%) had significant findings that could not be classified. These unclassifiable lesions fit into three distinct categories. Two of three patients described a traction injury to the shoulder. Only 8% sustained a fall on an outstretched arm; 75% had a preoperative history and provocative testing; however, when examined under anesthesia, 43% of the shoulders were considered to have increased humeral head translation when compared with the other shoulder. Recognition of superior labrum-biceps tendon detachment should prompt the surgeon to investigate glenohumeral instability as the source of a patient’s complaints.

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In a previous study, we used technetium-99 m bone scans to show that cooling a knee for 20 minutes with a standard ice wrap will decrease soft tissue blood flow by a mean of 26%, and skeletal blood flow and metabolism by 19%. The present study examined the effects of shorter and longer icing periods to determine minimum cooling time for a measurable and consistent decrease, and time to produce maximal decrease within a safe period of icing (<30 minutes). Thirty-eight subjects were studied. An ice wrap was applied to one knee for an assigned time (5, 10, 15, 20, or 25 minutes). Triple-phase bone scans of knees were obtained; mean percentages of decrease in the iced knee for each of the five time groups at each of the three phases of the bone scan were calculated and compared. Mean decreases of 11.1% in soft tissue blood flow, and 5.1% in skeletal metabolism and blood flow were measured at 5 minutes; maximums of 29.5% and 20.9%, respectively, were obtained at 25 minutes. A small but consistent decrease in soft tissue blood flow and skeletal blood flow and metabolism in a knee appear to be obtained with as little as 5 minutes of ice application. This effect is time-dependent and can be enhanced three- to four-fold by increasing the ice application time to 25 minutes.

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We know it is important to avoid excessive strain on reconstructed ligaments, but we do not know how individual muscles affect cruciate ligament strain. To answer this, we studied the effect of muscle forces and external loads on cruciate ligament strain. Nine cadaveric knee joints were tested in an apparatus that allowed unconstrained knee joint motion. Quadriceps, hamstring, and gastrocnemius muscle forces were simulated. Additionally, external...
loads were applied such as varus-internal or valgus-external rotation forces. Cruciate ligament strain was recorded at different knee flexion angles. Activation of the gastrocnemius muscle significantly \((p < .05)\) strained the posterior cruciate ligament at flexion angles larger than 40°. Quadriceps muscle activation significantly strained the anterior cruciate ligament when the knee was flexed 20° to 60° \((p < .01)\) and reduced the strain on the posterior cruciate ligament in the same flexion range \((p < .05)\). Activation of the hamstring muscles strained the posterior cruciate ligament when the knee was flexed 70° to 110° \((p < .05)\). Combined varus and internal rotation forces significantly increased anterior cruciate ligament strain throughout the flexion range \((p < .05)\). The results suggest that to minimize strain on the ligament after posterior cruciate ligament surgery, strong gastrocnemius muscle contractions should be avoided beyond 30° of knee flexion. The study also calls into question the use of vigorous quadriceps exercises in the range of 20° to 60° of knee flexion after anterior cruciate ligament reconstruction.

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1996 Request for Proposals
NEW - Education Grants!

The NATA Research & Education Foundation is pleased to announce that $100,000 is available in 1996 for Research and Education Grants. The deadlines for grant applications are March 1 and September 1 of each year. Priority consideration will be given to proposals which include an NATA-certified athletic trainer as an integral member of the research or project team.

RESEARCH GRANTS - $75,000 AVAILABLE

$50,000 is available to fund proposals which address important issues in four categories: basic science, clinical studies, sports injury epidemiology, and observational studies.

$25,000 is available to fund studies which investigate the validity and efficacy of therapeutic techniques, modalities, clinical procedures, and equipment used by allied health care practitioners.

EDUCATION GRANTS - $25,000 AVAILABLE

Education Research Grants include studies investigating teaching methods and evaluation and learning tools used in the area of athletic training education. Areas of particular interest to the Foundation are computer and competency-based learning and methods used to evaluate clinical learning skills. These grants range from $1,000 to $15,000.

Education Program Grants include seed money for seminars, lectures, or any other educational program focusing on health care of the physically active or athletic training education. Program topics of particular interest to the Foundation are closed-head injury, management of spinal conditions, on-the-field injury management procedures, and dysfunctional eating patterns. These grants range from $1,000 to $5,000.

To receive a copy of the Educational Grant Application or the Research Grant Application, please write to NATA Research & Education Foundation, 2952 Stemmons Freeway, Dallas, TX 75247, e-mail the request to BrianaE@aol.com, or call 800-TRY-NATA ext 142.
INSTRUCTIONS FOR SUBMISSION OF ABSTRACTS AND PROCESS FOR REVIEW OF ALL SUBMISSIONS

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

I. SPECIFIC CONTENT REQUIREMENTS: FREE COMMUNICATIONS ABSTRACTS

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

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

II. INSTRUCTIONS FOR PREPARING A FREE COMMUNICATIONS ABSTRACT:

1. Provide all information requested on the Abstract Author Information Form. Abstracts are to be typed or word processed using a LETTER QUALITY printer with no smaller than elite (12 cpi) or 10-point typeface. Do not use a dot-matrix printer.
2. Top, bottom, right, and left margins should be set at 1.5" using a standard 8.5" x 11" sheet of paper. Type the title of the paper or project in all CAPITAL letters on the left margin.
3. On the next line, indent 3 spaces and type the names of all authors with the author who will make the presentation listed first. Type the last name, then initials (without periods), followed by a comma; continue with the other authors (if any), ending with a colon.
4. Indicate the institution where the research or case report was conducted on the same line following the author(s) names.
5. Double space and begin typing the text of the abstract flush left in a single paragraph with no indentations. Do not justify the right margin.
6. The abstract should not exceed 500 words.

III. SPECIFIC CONTENT REQUIREMENTS: CLINICAL CASE REPORTS

This category of abstracts involves the presentation of unique individual athletic injury cases of general interest to our membership. Abstracts in this category must include the following information. This year, no form is provided so that authors may use their own word-processing software to format and submit the following information using
IV. INSTRUCTIONS FOR PREPARING A CLINICAL CASE REPORT ABSTRACT:

1. An individual may submit only one clinical case report abstract as primary (presenting) author; however, there is no limit to the number of abstracts (free communications or case reports) listing an individual as co-author.
2. Clinical case report abstracts are to be word-processed or typed using a letter-quality printer with no smaller than elite (12 characters per inch) or 10-point font. Do not use a dot-matrix printer.
3. Top, bottom, right, and left margins should be set at 1.5" using a standard 8.5" × 11" sheet of paper. Type the title of the paper or project in all CAPITAL letters on the left margin.
4. Provide all information requested on the information form below. Please note that the institution where the clinical case occurred should be cited, not the author(s)' current address, if different.
5. The title of the clinical case report should not contain information that may reveal the identity of the individual nor the specific nature of the medical problem to the reader. An example of a proper title for a clinical case report is, "Chronic Shoulder Pain in a Collegiate Wrestler".
6. Complete the six different categories of information as required for a clinical case report abstract. These categories are:
   a. PERSONAL DATA/PERTINENT MEDICAL HISTORY (provide the age, gender, sport/occupation of individual, their primary complaint, and pertinent aspects of their medical history).
   b. PHYSICAL SIGNS AND SYMPTOMS (a brief summary of the physical findings).
   c. DIFFERENTIAL DIAGNOSIS (array of possible injuries/conditions).
   d. RESULTS OF DIAGNOSTIC IMAGING/LABORATORY TESTS.
   e. CLINICAL COURSE (eg, diagnosis, treatment, surgical technique, rehabilitation program, final outcome).
   f. DEVIATION FROM THE EXPECTED (a brief description of what makes this case unique).

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

1. Complete the form 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 ACSIIL format; if you must send it in MacIntosh format, please use a high-density diskette) of your abstract and the following author information to:
   NATA-REF Free Communications
   2952 Stemmons Freeway
   Dallas, TX 75247

   MAILING ADDRESS OF PRESENTING AUTHOR (Please type; provide full name rather than initials)
   
   Name
   Address
   City, State, Zip
   Work Tel: FAX:
   NATA Membership Number
   
   Indicate the most appropriate TYPE for the presentation (check one only):
   _ Clinical Case Report Communication
   _ Free

   If FREE COMMUNICATION, indicate the most appropriate CATEGORY for your presentation (check one only):
   _ Basic Science Clinical Studies
   _ Educational Sports Injury
   _ Research Epidemiology
   _ Observational Studies

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

2. Abstracts POSTMARKED AFTER JANUARY 5, 1996 WILL NOT BE ACCEPTED.
Multi Phase Ankle Orthosis

Omni Scientific recently introduced a new acute ankle product, the Multi Phase Ankle Orthosis to treat acute ankle sprains by controlling edema. The Multi Phase provides prevention and removal of lateral ankle edema by application of focal compression to the soft tissues on the periphery of the fibular malleolus.

Additionally, the Multi Phase Ankle Orthosis provides Injury Stabilization from plantarflexion during the acute phases of ligament healing and prevents extreme inversion displacement. The Multi Phase converts from limited function (neutral-dorsiflexed) position to full function while continuing to provide focal compression and inversion control.

For information call 800-448-6664.

Active Ankle® Introduces New Athletic Ankle Brace

Active Ankle Systems is introducing its new Active Ankle T2®, a lighter, single-strap version of the athletic ankle brace.

The T2 features a durable, quick-fitting single-strap system that is adjustable for both high- and low-top shoes. That, combined with featherlight EVA padding that hugs every contour of the ankle, offers users a sleeker, less bulky brace as an alternative to the T1.

All Active Ankle braces feature a patented bilateral hinge and solid U shape to help prevent ankle injuries, while enabling injured athletes to engage in early return to activity following an injury.

For information call 800-800-2896.

Evac-U-Splint “Athletic Mattress”

Hartwell Medical of Carlsbad California announces the introduction of the Evac-U-Splint® Athletic Mattress.

The Evac-U-Splint® Mattress is designed very much like a large, flat bean bag which wraps around the injured athlete. When the athlete has been secured with the zig-zag strapping system with quick-release buckles, a hand pump is used to vacuum out the air, causing the mattress to become a rigid, form-fitting, full-body immobilizer.

The Evac-U-Splint Athletic Mattress molds to each athlete’s body contours by spreading the load of the athlete’s weight over a larger area, thereby reducing problems associated with injured athletes on the field prior to transporting.

The Evac-U-Splint Athletic Mattress replaces the need for various backboards, straps, and head immobilizers. Durable stain resistant material is easy to clean and disinfect. It is x-ray lucent and MRI compatible.

For information call 800-633-5900.

The Prevent S.O.-4 Shoulder Orthosis

The Prevent S.O.-4 is the first brace to effectively control external rotation of the shoulder. It is used for subluxing and dislocating shoulders. The “Prevent” uses a customized fit, four-component system to control horizontal extension, abduction, and external rotation of the shoulder. The four components; 1) non-migrating torso belt, 2) elbow joint, 3) forearm-humeral cuff, and 4) scapular wing are custom made from lightweight plastic that is comfortable and easily applied. The “Prevent” is made from plaster impressions of the arm and shoulder which are assembled with helmet hardware for your convenience and familiarity. This brace can be streamlined as the healing, strength, and proprioception increase. For information, call 708-361-3403.

Smith & Nephew DonJoy Introduces Pneumatic Knee Sleeve

Smith & Nephew DonJoy has introduced the “Air DonJoy™” Patellofemoral Knee Brace, a neoprene knee sleeve with sewn-in pneumatic pads designed to relieve the pain of patellofemoral disorders.
The slip-on Air DonJoy is designed as an alternative to the McConnell taping method, providing stabilization in patella tracking plus the additional benefits of ease of use and the warmth of Neoprene.

Constructed of one-eighth-inch thick premium neoprene, the brace has two sewn-in pneumatic pads to provide additional support to the patella region. Built-in pumps are used to inflate the pads to apply lateral or medial pressure to the patella. The Air DonJoy comes in six sizes and fits either the left or right knee.

For information call 800-336-6569.

The Dynatron 650 and 950

With the introduction of the Dynatron 650 and 950, the Dynatron 50 Series provides both two- and four-channel electrotherapy options, high-volt stimulation with pads or probes, and many other combination ultrasound and electrotherapy capabilities.

The Dynatron 650 and 950 electrotherapy provides four channels for simultaneous delivery of high volt, inter­ferential, premodulated, microcurrent, Russian and biphasic electrical stimulation. Combination electrotherapy and ultrasound treatments can be set up and administered. Treatment parameters such as range of frequency, ramp time, pulse rate, pulse width, duty cycle, polarity, and other treatment options can be modified before and during treatment.

The patented Target system is also available on the new devices. Target allows the user to focus treatment at the site of pain during interferential therapy without repositioning the electrodes.

The Dynatron 950 includes a Dynatronics-exclusive patent on multi-frequency ultrasound. The 2 cm², 5 cm², and 10 cm² sound heads each operate at 1, 2, and 3 MHz. The 1 cm² operates at 2 and 3 MHz.

For information call 800-874–6251.

Spectrum Therapy Introduces the DISC

Spectrum Therapy Products, Inc announces a new product to assist with trunk and back disorders. The DISC™ (Dynamic Integrated Stabilization Chair) offers clinical control over the functional progression of both ROM and strength during dynamic rehabilitation.

The design concept applies BAPS® type principles to back and trunk stabilization programs. It allows clinical control over the functional progression of strength and ROM stresses applied during therapeutic exercise. The proprioceptive system is addressed because the trunk is closed chain during these exercises.

While addressing the components of functional stability, the controlled limits to ROM provide a new measure of safety and patient confidence and compliance during sitting trunk exercise programs.

The system includes the Ortho DISC, as well as a pediatric sized version. A system for neuro-involved inpatients that includes a chair back, floor mat and hand rails is also available. Each system comes with its own BAPS balls for ROM functional progression.

For information call 800-231-2876.

Biodex Introduces New Electrotherapy Product—COMPEX 2

Biodex Medical Systems introduces the COMPEX 2 Electrotherapy System. The COMPEX is a portable and programmable, four-channel neuromuscular stimulator.

The COMPEX provides a TENS and NMES for pain, disuse atrophy, and muscle reinforcement. Programmable microchip memory cards contain preprogrammed or customized treatment sequences for specific indications to eliminate guesswork and maximize clinical efficiency. An LCD display indicates both treatment program status and patient compliance. Interchangeable modality modules allow for future capabilities of low-volt galvanic current for ion transfer and surface EMG.

For information call 516-924-9000.

Iomed, Inc. Announces TransQE

Iomed, Inc. Recently announced it has begun production of TransQE iontophoresis electrodes. TransQE electrodes are compatible with iontophoresis units from Empi® and Life-Tech® and are designed to give users of those units all the benefits of Iomed’s technology: stable drug pH regardless of the polarity, ease of use, and uniform current distribution.

SSC Technology utilizes a silver-silver chloride conductor to stabilize the drug’s pH throughout the entire treatment, regardless of the polarity, without buffers.

For information call 800-621-3347.
CURRENT LITERATURE

NUTRITION


TENS


WRESTLING

Perriello VA Jr, Almquist J, Conkwright D Jr, et al. Health and weight control management...


The NATA Board of Certification accepts this continuing education offering for .5 hours of prescribed CEU credit in the program of the National Athletic Trainers' Association, Inc, provided that the test is used and completed as designed.

Please note the new procedure for participating in this program. Read the material in this issue carefully, photocopy this page, and record your test answers on this page. It is no longer necessary to photocopy the test. Fill in your name, address and other information and mail with $15 for processing to the address below. FOR CREDIT, the form must be postmarked by March 15, 1995.

A passing score is 70% and those who pass are entitled to .5 CEU credit. Letters will be sent to all persons who participate, and will serve as proof of CEUs for those who pass. It is the individual's responsibility to report his/her CEUs to the NATA Board of Certification at the end of the CEU period. Participation is confidential.

### Answers to September '95 CEU Quiz

**Volume 30, Number 3**

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### INSTRUCTIONS

1. Carefully read the articles in this issue.
2. Photocopy this page.
3. Record your answers below by darkening the appropriate letter of your answer.
4. Mail with $15 fee (check or money order only payable to Indiana State University) postmarked by March 15, 1995 to:
   
   **JAT—CEU Quiz**
   
   Athletic Training Department
   
   Indiana State University
   
   Terre Haute, IN 47809

### CEU Quiz Evaluation

1. Questions challenging enough? . . . ☐Yes ☐No
2. Presented clearly? ............. ☐Yes ☐No
3. Material covered well? ............. ☐Yes ☐No
4. Will information be useful to you in your work? ............. ☐Yes ☐No

Please add any suggestions on how to improve the CEU Quiz on the back of this form when you are finished.
1. Some clinical implications of the study on sensory information and cold are:
   a. Even though athletes may have had previous experience with cold, some form of sensory information before treatment will act as a modifier to what they will experience.
   b. Pain is less when given any sensory information than when no sensory information is given.
   c. Promise of a minimal pain experience makes no difference in what the athlete actually feels.
   d. Athletes will be more apt to complete rehabilitation when given sensory information before treatment.
   e. All except c.

2. A comparison of anterior knee laxity in female intercollegiate gymnasts to a normal population found the following difference:
   a. Gymnasts had a greater anterior laxity than nongymnasts.
   b. Nongymnasts had a greater anterior laxity than gymnasts.
   c. There was no significant difference between gymnasts and control subjects.
   d. No conclusions could be made from the measurements.

3. Exertional rhabdomyolysis:
   a. Can occur in normal, healthy individuals following strenuous exercise.
   b. Occurs only in individuals who are poorly conditioned or who have the sickle cell trait.
   c. Can result in renal failure and sudden death.
   d. Both a and c.
   e. Both b and c.

4. Athletes nutritional concerns generally have revolved around:
   a. Identification of high carbohydrate versus high fat foods.
   b. Suggestions to increase lean body mass.
   c. The minimal amount of food to eat and yet still meet the nutritional requirements.
   d. A and b.
   e. All of the above.

5. A study comparing isokinetic and isotonic closed kinetic chain training on one-legged jump reaction force concluded that:
   a. Changes in isokinetic force developed in a nonweight bearing closed kinetic chain directly translates into increased force production during a functional activity, but isotonic weight lifted does not.
   b. Changes in isotonic weight lifted directly translates into increased force production, but isokinetic force does not.
   c. Changes in neither isokinetic force nor isotonic weight lifted in a nonweight bearing closed kinetic chain directly translate into increased force production during a functional activity.
   d. Isokinetic exercise has more advantages than isotonic exercise when training muscle during rehabilitation.
   e. Isokinetic exercise should be the more frequently used training method for injury prevention.

6. Liver lacerations:
   a. Are almost always associated with massive bleeding.
   b. Almost always require surgery.
   c. Often involve the right lobe.
   d. Are almost always fatal.
   e. None of the above.

7. Reproductions in a portfolio can include:
   a. Videotape of class presentations.
   c. Overhead transparencies.
   d. Research papers.
   e. All except d.

8. Athletes who suffer injuries:
   a. Recover faster through goal setting, positive self-talk, and mental imagery during rehabilitation.
   b. Recover at the same rate with or without psychological help.
   c. Often exhibit increased depression and have reduced self-esteem scores.
   d. Both a and c.
   e. Both b and c.

9. Overuse, hypervascularity, bony configuration and ______ can lead to shoulder impingement in swimmers:
   a. Proper stroke techniques.
   b. Equal strength of both the internal and external rotators.
   c. Good flexibility.
   d. All of the above.
   e. None of the above.

10. Complications to nonoperative management of liver trauma might include:
    a. Arteriovenous fistula.
    b. Hemobilia.
    c. Pneumonia.
    d. All of the above.
    e. B and c only.

11. The Performance Enhancement Group program is designed to:
    a. Improve the psychological health of the athlete who has sustained an injury.
    b. Support the athlete mentally but not physically.
    c. Focus on the athletic trainer as the primary professional responsible for all aspects of the athlete's rehabilitation.
    d. Help severely depressed athletes only.
    e. Both a and d.

12. The "stretching window," or time period when tissues will undergo the greatest extensibility and elongation following ultrasound application, is applicable for:
    a. Adhesive capsulitis.
    b. Tendinitis.
    c. Joint contractures.
    d. Tendons.
    e. All except d.

    a. True.
    b. False.

14. One outcome of the study of the effect of sensory information on cold-induced pain was:
    a. Subjects in the high-level and traditional terms groups experienced more sensory and affective pain than the other groups.
    b. Subjects in the control group experienced more sensory and affective pain than the others.
    c. Subjects in the control group experienced more evaluative pain than others.
    d. Subjects in the moderate-level group experienced the most miscellaneous pain.
    e. Both b and c.

15. Which of the following can help to prevent exertional rhabdomyolysis in athletes with sickle cell trait?
    a. Educate athletes about the danger of the diuretic effect of caffeinated beverages.
    b. Implement aggressive nonhydration policies before, during, and after all activity.
    c. Avoid strenuous exercise at altitudes above 5000 feet.
    d. All of the above.
    e. A and c only.
10. Begin numbering the pages of your manuscript with the style policies.

11. Titles should be brief within descriptive limits (a 16-word maximum is recommended). The name of the disability treated should be included in the title if it is the relevant factor; if the technique or type of treatment used is the principle reason for the report, it should be in the title. Often both should appear.

12. The title page should also include the names, titles, and affiliations of each author, and the name, address, phone number, and fax number of the author to whom correspondence is to be directed.

13. A comprehensive abstract of 75 to 200 words must accompany all manuscripts except Tips From the Field. Number this page one, type the complete title (but not the author's name(s) on the top, skip two lines, and begin the abstract. It should be a single paragraph and succinctly summarize the major intent of the manuscript, the major points of the body, and the author's summary and conclusions. It is unacceptable to state in the abstract words to the effect that "the significance of the information is discussed in the article." Also, do not confuse the abstract with the introduction.

14. List three to six key words or phrases that can be used in a subject index to refer to your paper. These should be on the same page as, and following your abstract. For Tips From the Field, follow immediately after the title on the first numbered page.

15. Begin the text of the manuscript with an introductory paragraph or two in which the purpose or hypothesis of the article is clearly developed and stated. Tell why the study needed to be done or the article written and culminate with a statement of the problem (or controversy). Highlight the most prominent works of others as related to your project; they are often appropriate for the introduction, but a detailed review of the literature should be reserved for the discussion section. In the one to two paragraph review of the literature, identify and develop the magnitude and significance of the controversy, pointing out differences between others' results, conclusions, and/or opinions. The introduction is not the place for a detailed review of the literature. Also, an overview of the manuscript is part of the abstract, not the introduction.

16. The body or main part of the manuscript varies according to the type of article. For the review article, the body should include a discussion section in which the importance of the material presented is discussed and related to other pertinent literature. Liberal use of headings and subheadings, charts, graphs, and illustrations is encouraged.

a. The body of an Experimental Report consists of a methodology section, a presentation of the results, and a discussion of the results. The methodology section should contain sufficient detail concerning the methods, procedures, and apparatus employed so that others can reproduce the results. The results section should be summarized using descriptive and inferential statistics, and a few well-planned and carefully constructed illustrations.

b. The body of a Review of the Literature article should be organized into subsections in which related thoughts of others are presented, summarized, and referenced. Each subsection should have a heading and brief summary, possibly one sentence. Sections must be arranged so that they progressively focus on the problem or question posed in the introduction.

c. The body of a Case Study should include the following components: personal data (age, sex, race, marital status, and occupation when relevant—but not name), chief 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 re-turn to competition, and deviation from the expected (what makes this case unique). NOTE: It is mandatory that the Journal of Athletic Training receive, with the manuscript, a release form signed by the individual being discussed in the case study. Case studies cannot be reviewed if the release is not included.

d. The body of a Technique Article should include both the how and why of the technique, a step-by-step explanation of how to perform the technique, supplemented by photographs or illustrations; and why the technique should be used. The discussion of why should review similar techniques, point out how the new technique differs, and explain the advantages and disadvantages of the technique in comparison to other techniques.

e. A Tip From the Field is similar to a technique article but much shorter. The tip should be presented and its significance briefly discussed and related to other similar techniques.

17. The manuscript should not have a separate summary section—the abstract serves as a summary. It is appropriate, however, to tie the article together with a summary paragraph or list of conclusions at the end of the discussion section.

18. Citations in the text of the manuscript take the form of a superscript number, which indicates the number assigned to the citation. It is placed directly after the reference or the name of the author being cited. References should be used liberally. It is unethical to present others' ideas as your own. Also, use references so that readers who desire further information on the topic can benefit from your scholarship.

19. The reference page(s) accompanying a manuscript should list authors numerically in alphabetical order, should be in the following form: a: articles: author(s) (list all) with the family names then initials, title of article, journal title with abbreviations as per Index Medicus (italized or underlined), volume, year, inclusive pages; b: books: author(s), title of book (underlined), city, state of publication, publisher, year, inclusive pages of citation. Examples of references to a journal, book, presentation at a meeting are illustrated below. See the AMA Manual of Style for other examples.


d. Behnke RL. Literature for athletic trainers: problems and solutions. Presented at the 29th Annual Meeting and Clinical Symposium of the National Athletic Trainers' Association; June 15, 1978; Las Vegas, NV.

20. Tables must be typed. See references cited in #5 or #10a for table formatting.

21. Type legends to illustrations on a separate page followed by Xerox copies of the illustrations. Photographs should be glossy black and white prints. Do not use paper clips, write on photos, or attach photos to sheets of paper. Carefully attach a write-on label to the back of each photograph so that the photograph is not damaged. Graphs, charts, or figures should be of good quality and clearly presented on white paper, 3½" or 7½" wide, with black ink, 8 to 10 point sans serif typeface, no box, and printed on laser printer—no dot matrix.

22. All artwork to be reproduced should be submitted as camera-ready black and white line art. If artwork is to be reproduced in black plus a second (or more) color, it should be submitted as black and white line art. Clearly mark each area of color, or areas of shading or screening (a percent or tint of black or a color), on a separate photocopy. Authors will pay for color.
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<tbody>
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</tbody>
</table>
## AUTHOR INDEX

### A

- Allen JR: see Madaleno JA
- Amhold RW: see Mathies AL
- Arnold BL: A review of selected blood-borne pathogen position statements and federal regulations, 30:171

### B

- Badyylak SF: see Hodde JP
- Baer JT, Walker WF, Grossman JM: A disordered eating response team's effect on nutrition practices in college athletes, 30:315
- Bazuin D: see Ray R
- Beam JW, Lozman PR, Uribe JW: Surgical treatment of chronic patellar tendinitis in a collegiate football player, 30:342
- Bell GW: see Wells MJ
- Brannan TL, Schulthies SS, Myrer JW, Durrant E: A comparison of anterior knee laxity in female intercollegiate gymnasts to a normal population, 30:298
- Brkich M: Infectious waste disposal plan of the high school athletic trainer, 30:208
- Bunton EE: see Pitney WA
- Buxton BP, Okasaki EM, Ho KW, McCarthy MR: Legislative funding of athletic training positions in public secondary schools, 30:115

### C

- Curtis N: Closed kinetic chain terminal knee extension using a padded elastic band, 30:270
- Curtis N: Teacher certification among athletic training students, 30:349

### D

- Davis VL: see Keskula DR
- Decoster LC, Vailas JC: Fracture through the distal femoral epiphysis, 30:154
- Dell'Omo DL: see Keskula DR
- Denagar CR: see Mathies AL
- Dowling JS: see Keskula DR
- Draper DO: see Schulthies DD
- Draper DO, Ricard MD: Rate of temperature decay in human muscle following 3 MHz ultrasound: the stretching window revealed, 30:304
- Durrant E: see Brannan TL

### E

- Evans TA, Ingersoll C, Knight KL, Worrell T: Agility following the application of cold therapy, 30:231

### F

- Farrell RN: see Ray R
- Fincher AL: see Harrelson GL
- Finley PW: see Keskula DR
- Fisher J: see Trocchio M
- Foster DT, Rowedder LJ, Reese SK: Management of sports-induced skin wounds, 30:135

### G

- Gansneder BM: see Guskiewicz KM
- Giangarra CE: see McHugh-Pierzina VL
- Goldenberg MS, Hossler PH: Head and facial injuries in interscholastic women's lacrosse, 30:37
- Granito Jr VL, Hogan JB, Varnum LK: The performance enhancement group program: integrating sport psychology and rehabilitation, 30:328

### H

- Hannam SE: Portfolios: an alternative method of student and program assessment, 30:338
- Harrelson GL, Fincher AL, Robinson JB: Acute exertional rhabdomyolysis and its relation to sickle cell trait, 30:309
- Heck JF: A survey of New Jersey high school football officials regarding spearing rules, 30:63
- Ho KW: see Buxton BP
- Hodde JP, Badyylak SF, May CL, Smith GF: Infective endocarditis in a collegiate wrestler, 30:105
- Hogan JB: see Granito Jr VL
- Hossler PH: see Goldenberg MS

### I

- Ingersoll C: see Evans TA
- Ingersoll CD: see Cordova ML; Streator S
- Irgang JJ: see Pezzullo DJ

### J

- Jacobson KE: see Madaleno JA
- Johnson B: see Tracy JE

### K

- Kahler DM: see Guskiewicz KM
- Karas S: see Pezzullo DJ
- Kemler D: see Misasi S
- Kemnzek TW: see Lindley TR
- Keskula D, Sammerone PG, Perrin DH: Prediction of academic achievement in an NATA-approved graduate athletic training education program, 30:55
- Keskula DR, Dowling JS, Davis VL, Finley PW, Dell'Omo DL: Interrater reliability of isokinetic measures of knee flexion and extension, 30:167
- King D: Glenohumeral joint impingement in swimmers, 30:333
- Klabunde LA: see Johnson BC
- Klabunde LA: see Johnson BC
- Knight KL: see Cordova ML; Evans TA; Streator S
- Knight KL: Guidelines for preventing blood-borne pathogen diseases, 30:197
- Koester MC: Refocusing the adolescent preparticipation physical evaluation toward preventive health care, 30:352
- Kokkaliaris J: see Paris DL
- Kovaleski JE: see Cordova ML
Latuda LM: see Richardson PA
Lebsack DA: see Mattacola CG
Lemire JE: see Ray R
Liggett CL, Tandy RS, Young JC: The effects of prophylactic knee bracing on running gait, 30:159
Lindley TR, Kemozek TW: Taping and semirigid bracing may not affect ankle functional range of motion, 30:109
Litt DW: Acute subdural hematoma in a high school football player, 30:69
Lozman PR: see Beam JW
Luchies C: see Ray R

Madaleno JA, Allen JR, Jacobson KE: Septic arthritis in a collegiate football player, 30:361
Martin DE: see Guskiewicz KM
Masssey AN: see Moul JL
Mathies AL, Denegar CR, Amhold RW: Changes in athletic training education as a result of changing from NATA-PES to CAAHEP, 30:129
May CL: see Hodde JP
McCann P: see Toy BJ
McCarty MR: see Buxton BP
McCue FC: see Guskiewicz KM
McHugh-Pierzina VL, Zillmer DA, Giangarra CE: Thoracic compression fracture in a basketball player, 30:163
Misasi S, Morin G, Kemler D, Olmstead PS, Pryzgocki K: The effect of a toe cap and bias on perceived pain during cold water immersion, 30:49
Morin G: see Misasi S
Morse DE: see Toy BJ
Moul JL, Masssey AN: Recurrent metatarsal stress fractures in a college football lineman, 30:72
Myrer JW: see Brannan TL

Obuchi S: see Tracy JE
Okasaki EM: see Buxton BP
Olmstead PS: see Misasi S

Page P: Pathophysiology of acute exercise-induced muscular injury: clinical implications, 30:24
Paris DL, Vardaxis V, Kokkaliaris J: Ankle ranges of motion during extended activity periods while taped and braced, 30:223
Parkman AW: see Trocchio M
Perrin DH: see Guskiewicz KM; Keskula D; Mattacola CG
Pezzullo DJ, Karas S, Irrgang JJ: Functional plyometric exercises for the throwing athlete, 30:22
Pitney WA, Buxton EE: Improving rehabilitation effectiveness by enhancing the creative process, 30:261
Pryzgocki K: see Misasi S

Randall T: Glenoid dysplasia, 30:259
Ray R, Lemire JE: Liver laceration in an intercollegiate football player, 30:324

Ray R: An electronic daily injury report system, 30:180
Reese SK: see Foster DT
Reuter BH: Taping the hammer toe, 30:178
Rheinecker SB: Wound management: the occlusive dressing, 30:143
Ricard MD: see Draper DO
Richardson PA, Latuda LM: Therapeutic imagery and athletic injuries, 30:16
Riney SM, Goldman SJ, Johns J: Prevention of lateral hip injuries in competitive figure skaters, 30:75
Robinson JB: see Harrelson GL
Rowedder LJ: see Foster DT

Sabo JM: An alternative material for silicone casting, 30:345
Sammrone PG: see Keskula D
Schulties SS: see Brannan TL
Schulties SS, Draper DO: A modified low-dye taping technique to support the medial longitudinal arch and reduce excessive pronation, 30:266
Smith A: Supraspinal neuropathy in a collegiate pitcher, 30:43
Smith GF: see Hodde JP
Starkey C, Henderson J: Performance on the athletic training certification examination based on candidates' routes to eligibility, 30:59
Streator S, Ingersoll CD, Knight KL: Sensory information can decrease cold-induced pain perception, 30:293

Tandy RS: see Liggett CL
Toy BJ, Yeasting RA, Morse DE, McCann P: Arterial supply to the human anterior cruciate ligament, 30:149
Tracy JE, Obuchi S, Johnson B: Kinematic and electromyographic analysis of elbow flexion during inertial exercise, 30:254
Trocchio M, Wimer JW, Parkman AW, Fisher J: Oxygenation and exercise performance-enhancing effects attributed to the Breath-Right nasal dilator, 30:211

Uribe JW: see Beam JW

Vailas JC: see Decoster LC
Vardaxis V: see Paris DL
Varnum LK: see Granito Jr VL

Walker WF: see Baer JT
Waller HD: Nonoperative rehabilitation of an isolated posterior cruciate ligament rupture, 30:15
Wells MJ, Bell GW: Concerns on Little League elbow, 30:249
Wimer JW: see Trocchio M
Worrell T: see Evans TA

Yeasting RA: see Toy BJ
Young JC: see Liggett CL
Knee flexion/extension, isokinetic measures, 30:167
Knee injury rehabilitation, 30:270
Knee joint, 30:154

L
Lacerations, 30:37
Lacrosse, women's, 30:37
Leg press exercise, 30:319
Legislative funding, 30:115
Little League elbow, 30:249
Liver laceration, 30:324
Lower extremity injuries, 30:159

M
McGill Pain Questionnaire, 30:49
Medial femoral condyle, 30:154
Medial longitudinal arch, 30:266
Metatarsal phalangeal joint, 30:178
Metatarsal stress fracture, recurrent, 30:72
MRI diagnostic role, 30:15
Muscle, human, 30:304
Muscle degeneration, 30:309
Muscle loading techniques, 30:254
Muscle performance, 30:167
Muscle soreness, 30:29
Muscular injury, exercise-induced, 30:29
Muscular strength, 30:22

N
Nasal dilator, 30:211
Nasal gas conduction, 30:211
NATA-PEC, 30:129
Neck injuries, 30:63
Neuropathy, subscapular, 30:43
Nutrition practices, 30:315

O
Occlusive dressing, 30:143
Omni Anderson Knee Stabler, 30:159
Orthosis, ankle, 30:109
Overuse injuries, 30:249
Oxygenation, 30:211

P
Pain, perceived, 30:49
Pain perception, 30:293
Patellar tendinitis, 30:342
Pathogenic organisms, 30:143
Patient care procedures, 30:171
Peak torque, 30:167
Performance Enhancement Group program, 30:328
Physical evaluation, 30:352
Physical performance, 30:231
Plantar flexion, 30:72
Plyometric exercises, 30:22
Portfolios, 30:338
Posterior cruciate ligament rupture, 30:15
Postural sway, 30:237
Program assessment, 30:338
Pronation, excessive, 30:266
Psychological health, 30:328

R
Range of motion exercises, 30:304
Rehabilitation, 30:319, 30:328
Rehabilitation, imagery use in, 30:10
Rehabilitation, knee injury, 30:270
Rehabilitation, nonoperative, 30:15
Rehabilitation effectiveness, 30:261
Rehabilitation process, 30:10
Rehabilitation strategies, 30:261
Renal failure, 30:309
Rhabdomyolysis, exertional, 30:309
Risk factors, 30:309
Rotator cuff pathology, 30:259
Rubber, silicone, 30:345

S
Salter-Harris III fracture, 30:154
Scar tissue, 30:143
Secondary schools, 30:115
Sensory information, 30:293
Septic arthritis, collegiate football player, 30:361
Shoulder, throwing athlete, 30:22
Shoulder pain, 30:43, 30:259, 30:333
Shoulder soreness, 30:43
Sickle cell trait, 30:309
Silicone casting, 30:345
Skin wounds, sports-induced, 30:135
Soccer player, 30:15
Squeaking rules, 30:63
Spinal fracture, 30:163
Sport, muscle injuries, 30:22
Sports psychology, 30:328
Sprinting, 30:109
Staphylococcus aureus infection, 30:105
Static balance, 30:237
Stepwise Discriminant Analysis Function, 30:49
Strains, 30:29
Strengthening exercises, 30:22
Stress fracture, 30:72
Stretching window, 30:304
Student assessment, 30:338
Student grade point average, 30:55
Subdural hematoma, 30:69
Superficial wounds, 30:143
Suprascapular neuropathy, 30:43
Surgical treatment, 30:342
Swimmers, 30:333
Swimmer's shoulder, 30:333

T
Tackling injuries, 30:324
Taping, ankle, 30:109
Taping, hammer toe, 30:178
Taping technique, low-dye, 30:266
Teacher certification, 30:349
Temperature decay, 30:304
Test results, 30:59
Therapeutic care, 30:10
Thoracic compression fracture, 30:163
Thoracolumbar pain, 30:163
Throwing athlete, 30:22
Tibia translation, 30:243
Tibial rotation, 30:243
Toe cap, 30:49
Trauma, repetitive, 30:72

U
Ultrasound, 3 MHz, 30:304

V
Valgus loading, 30:154
Vascular structure, 30:149

W
Work values, 30:167
Wound management, 30:143
Wound management, skin, 30:136
Wrestler, collegiate, 30:105

X
X rays, 30:15
## ADVERTISING INDEX

<table>
<thead>
<tr>
<th>Company</th>
<th>Page(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIRCAST</td>
<td>332</td>
</tr>
<tr>
<td>BAILEY MANUFACTURING COMPANY</td>
<td>308</td>
</tr>
<tr>
<td>BRACE INTERNATIONAL</td>
<td>314</td>
</tr>
<tr>
<td>BREATHE RIGHT/CNS, INC.</td>
<td>290</td>
</tr>
<tr>
<td>COMPUTER MANAGEMENT SCIENCES, INC.</td>
<td>296</td>
</tr>
<tr>
<td>FOOT MANAGEMENT, INC.</td>
<td>301, 384</td>
</tr>
<tr>
<td>GATORADE/QUAKER OATS COMPANY</td>
<td>297</td>
</tr>
<tr>
<td>JAYBIRD &amp; MAIS</td>
<td>327</td>
</tr>
<tr>
<td>JOHNSON &amp; JOHNSON</td>
<td>302, 303</td>
</tr>
<tr>
<td>MCDAVID SPORTS MEDICAL, INC.</td>
<td>323</td>
</tr>
<tr>
<td>MUELLER SPORTS MEDICINE, INC.</td>
<td>313</td>
</tr>
<tr>
<td>MULTIAXIAL, INC.</td>
<td>360</td>
</tr>
<tr>
<td>PROFESSIONAL MEDICAL PRODUCTS</td>
<td>318</td>
</tr>
<tr>
<td>PROTEK-TOE PRODUCTS</td>
<td>341</td>
</tr>
<tr>
<td>SWEDE-O-UNIVERSAL</td>
<td>292</td>
</tr>
<tr>
<td>UNITED STATES SPORTS ACADEMY</td>
<td>348</td>
</tr>
<tr>
<td>PRO ORTHOPEDIC DEVICES</td>
<td>Cover 2</td>
</tr>
<tr>
<td>LENOX HILL BRACE CO.</td>
<td>Cover 3</td>
</tr>
<tr>
<td>CRAMER PRODUCTS, INC.</td>
<td>Cover 4</td>
</tr>
</tbody>
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