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More on Carpal Tunnel Syndrome

I would like to compliment Mr. Zimmerman on his excellent review of Carpal Tunnel Syndrome (JAT 1994;29:22-30). His article should certainly increase awareness of median nerve entrapment at the wrist and hopefully his article will be the impetus for further study of peripheral entrapment neuropathies.

I would like to clarify a few points in his article. He mentions that Electromyography may show fibrillations or F-wave abnormalities in the paraspinous muscles with cervical radiculopathy. The F-wave is a nerve conduction study and cannot be demonstrated with EMG of the cervical paraspinals. The F-wave, originally described by Magladery and McDougal in 1950, is a late response recorded at a longer latency than the motor response when electrical stimulation is used to activate the peripheral nerves in small hand or foot muscles. Since the original report, there has been a great deal of debate as to the origin and significance of the F-wave. Presently, it is agreed to originate by antidromic stimulation of motor fibers resulting in orthodromic excitation of a small percentage of the alpha motor neurons.

I would also like to point out and give proper credit to the authors, that the term “double crush” syndrome was first described by Upton and McComas in 1973 in Lancet. The fact that a double crush syndrome can exist is one of the reasons that Nerve Conduction and EMG testing should be the benchmark examination prior to any surgery on the carpal tunnel, rather than it being “occasionally required” as Mr. Zimmerman states. It is absolutely inexcusable to have operated on the wrist when in fact the symptoms were cervical in nature. In the December 93 issue of “Muscle and Nerve,” Jablecki et al of the American Association of Electrodiagnostic Medicine Quality Assurance Committee performed a literature review of the usefulness of nerve conduction studies and electromyography for the evaluation of patients with carpal tunnel syndrome. After review of 165 articles, they concluded that median sensory and motor nerve conduction studies are valid and reproducible clinical laboratory studies and confirm a clinical diagnosis of CTS in patients with a high degree of sensitivity and specificity. They also stated that the value of performing F-wave studies in the evaluation of patients with CTS remains to be established.

Electrodiagnostic testing is an easy, reproducible test that can determine the degree of involvement, i.e., whether it is sensory, motor, demyelinating, axonal, or any combination of these with a high degree of specificity and should be considered when establishing a diagnosis of CTS and definitely ordered prior to surgery.

Again, I would like to thank Mr. Zimmerman for an excellent review and I would implore the readers to become familiar with the many common entrapment neuropathies in both the upper and lower extremities.

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Drug Screening

I found Starkey, Abdenour, and Finnian’s article, “Athletic Trainer’s Attitudes Toward Drug Screening” (JAT 1994;29:120-125) interesting, timely, and disturbing. Interesting and timely in suggesting that athletic trainers’ attitudes on this whole “drug issue” appear as confused, inconsistent, and paranoid as those of society as a whole. Distressing in how quickly intelligent people are willing to forfeit the athletes’ and their own civil rights in a hysterical march to fight a supposed drug scourge that has not even been proven to exist.

If drug abuse is a medical problem, then the medical staff, including the athletic trainer, should be involved in the diagnosis and treatment of the problem. Privacy should be thus guaranteed and punitive action should not even be entertained. If drug use is a criminal problem, who’s been harmed, the ticket office? All the rules of criminal evidence collection, including the establishment of probable cause, ought to be adhered to. One must also ask why, or rather, should athletic departments and athletic trainers be in the law enforcement business?

I suggest that drug abuse is a medical problem and should be treated as such; drug use is a public relations problem and putting fannies in the seats is no reason to trample on our citizens’ civil rights. Fortunately, the US Supreme Court agreed in May of 1994, when upholding the Colorado Supreme Court’s decision that the University of Colorado’s random drug testing program violates the 4th Amendment’s privacy guarantees.

In Wisconsin one can still hear the echo of a similar hysterical, Tailgunner Joe McCarthy: “Are you or have you ever been a member of the Communist Party?” Have we not yet learned over the last 40 years to say “None of your damn business!”

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Abstract: Most high school and some collegiate athletes are legal minors. In civil matters, the law treats minors (usually individuals under the age of 18 years) uniquely. Limitations exist on a minor's ability to enter into contracts, make determinations regarding medical care, and bear responsibility for personal actions. Medical professionals are often unclear on matters relating to the provision of medical care to minors. The purpose of this discourse is to present selected legal issues in the context of two fictional case studies. Case 1 presents issues regarding the definition of emergency medical conditions and the related emergency medical doctrine. Case 2 provides an example of an acute medical concern which fails to fall under emergency medical classification but rather provides a context for discussing the mature minor doctrine. Both cases are analyzed in light of these doctrines in addition to other pertinent legal considerations.

Many athletic trainers have the opportunity to work with athletes who are legal minors. Special legal concerns present themselves during interactions with minors including consent for emergency medical care, nonemergency care of the mature minor, and the salience of consent forms often used by schools and athletic organizations.

When treating minors, no medical procedures should be performed without consent of a parent or guardian. However, parents cannot always be contacted at the time of an emergency. For this reason, legislatures and courts have articulated what can be referred to as the emergency medicine doctrine for minors. The Juvenile Justice Standards Project, Rights of Minors, Part IV: Medical Care (JJSP) outlines conditions under which a minor may receive medical care without parental consent. The JJSP states that medical treatment may be administered when, “Emergency situations exist when delaying treatment to first secure parental consent would endanger the life or health of a minor.” This doctrine is present in most state statutes to deal with consent for emergency medical care.

The JJSP was initiated by the American Bar Association in the 1970s in an attempt to meet four basic needs: 1) achieve uniformity in the law relating to minors, regardless of jurisdiction; 2) develop linkages within the justice system to promote coordinated treatment of minors; 3) re-examine concepts underlying current laws and evaluate their strengths and weaknesses; and 4) codify relevant case material to serve, not as law, but potentially as a model for state acts and statutes. This 23-volume series of analysis of current legal thought provides a comprehensive basis for the development of policies for dealing with minors’ affairs in the legal system. The standards have been developed with the underlying premise that juveniles should have the right to decide on actions which affect their lives, unless they are found to be incapable.

Mature minor doctrine defines the degree to which a minor, close to the age of majority, may determine the course of his or her medical care. The ability of a minor to enter into contracts varies from state to state. Decisions regarding nonemergency medical care are increasingly being placed in the hands of mature, capable minors.

The following fictional cases illustrate the practical application of many legal concepts in athletic training scenarios.

Case 1
Winston was a 16-year-old junior varsity football player. He attended a coed boarding school on the West Coast. His parents worked for the government and were living in Great Britain. In August, Winston entered school to begin preseason football practice. Prior to participation, he underwent a physical examination administered by the school physician and the athletic trainer, and was cleared for participation. His parents signed a consent form authorizing the school to act en loco parentis (in the place of parents and/or legal guardians) in all matters pertaining to his care and signed an additional release of liability form for participation in interscholastic athletics.

During the second week of two-a-day practices, Winston began losing weight and complained of recurring headaches. The athletic trainer encouraged him to increase his fluid intake to minimize the risk of dehydration and concomitant heat-related illness.

On a Thursday, during full-contact practice, Winston tackled an offensive player and fell to the ground, motionless. A student athletic trainer observed that Winston was disoriented and concomitant heat-related illness.

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Winston was unresponsive and his pulse and respirations were weak. The athletic trainer determined that Winston was suffering from heat stroke compounded by a possible neurologic insult. Due to the remote location of the school, the school physician requested the dispatch of an Emergency Medical Service to transport Winston to the hospital. During the 45 minutes prior to the arrival of the EMS transport, the athletic director attempted to make contact with Winston’s parents with no success. The athletic trainer provided care for heat stroke and episodes of cardiac arrest while waiting for the EMS to arrive. At the hospital, Winston was diagnosed as having severe heat stroke. He was admitted for 2 days, during which time he was rehydrated. His parents were notified of the emergency 36 hours after the episode.

Case 2
Samantha was a 17-year-old swimmer. While diving into a pool during summer vacation, Samantha dislocated her shoulder. She was taken to the emergency room, where the anterior glenohumeral dislocation was reduced.

While training for the backstroke, her shoulder repeatedly subluxated, at which times she was able to “pop” it back into place. As the swimming season arrived, she had too much pain to effectively train or compete. Conservative nonoperative treatment was ineffective in adequately stabilizing the joint. The athletic trainer referred her to a consulting orthopedist who recommended a surgical stabilization of the anterior joint capsule. Because she was planning on swimming in college, she requested that the operation be scheduled.

Discussion
Emergency medical care requires special medical and legal consideration. Due to the nature of many emergency conditions, the provision of consent—ideally informed consent—is problematic in light of impaired mental status. In most jurisdictions, patients are assumed to consent to emergency medical care unless previous orders regarding the refusal of medical care have been enacted (Do Not Resuscitate (DNR) orders, and the like). Prior to treating conscious, competent, injured adults, informed consent must be obtained.

Statutes authorizing emergency medical care for minors are widespread. Furthermore, those individuals who provide emergency medical care to minors enjoy certain protections from civil liability. A review of all immunity statutes would be cumbersome, but selected statutes demonstrate the wide range of specific protections provided by the law for individuals providing emergency medical care to minors. Any individual may provide emergency transportation and medical care to a child if no ambulance is available in Arizona. In Arkansas, teachers, school health providers, and other school personnel are immune from civil liability for providing emergency medical care to minors. The California Education Code provides immunity for individuals providing emergency medical care to athletes and states that no community college, agent thereof, or physician shall be liable for illness or injury regardless of parental consent. The California, Virginia, and several other states provide physicians immunity from civil liability when providing emergency medical care to athletes (minor or adult) without compensation.

Statutes authorizing emergency medical care for minors do not discourage attempts to obtain parental consent. On the contrary, most mandate parental notification as soon as possible. It is essential to realize that parental consent is not necessary when life and limb are compromised by a delay while attempting to obtain parental consent. Barring gross negligence and/or willful and wanton misconduct, all medical personnel in Case 1 were free to provide necessary medical care without threat of civil liability. In Case 2, because the condition, though acute, was not an emergency, parental consent was necessary.

No state requires a signed medical release to authorize emergency medical care for minors. In Case 1, Winston would have received emergency medical care from the athletic trainer, the school physician, and the hospital emergency personnel regardless of the parental signatures on a consent form. Case 2 presents an entirely different medical situation, for no true emergency existed. The courts have been unified in the stipulation that for the emergency medical doctrine to be relevant, a true emergency must exist. Duda v. Gaines was an action brought by parents of a high school football player against defendants from the boy’s high school. During football practice, the athlete had a shoulder dislocation which was reduced. Subsequently, he had recurring shoulder pain and stability deficits. The boy’s parents alleged that the school personnel should have sought and provided medical care for the shoulder injury. The case was dismissed due to lack of evidence. The court did state that this condition was not an emergent one and therefore, it was incumbent on the parents to solicit medical care. In Duda v. Gaines, the court clearly mandates that medical care without parental consent is only authorized in cases which represent true emergencies.

Case 2 provides a scenario in which the party responsible for providing consent may not necessarily be a parent. Samantha was 17 years old. Many states have embraced the mature minor doctrine. The mature minor doctrine empowers minors who have sufficient mental capacity to understand and comprehend the nature of a medical procedure, the risks involved and the probability of attaining the desired results to provide consent for themselves. The JJSP suggests that a minor who consents for treatment, under the mature minor doctrine, should be accountable for the costs incurred for such treatment.

Statutes are varied in existence and scope regarding consent for non-emergency medical care. Many states describe who can consent for
medical treatment for minors. Individuals standing en loco parentis are authorized to provide consent for necessary medical procedures.\textsuperscript{1,4,8,15} In addition, consent for medical services can be provided by the court in most states.

The mature minor doctrine interfaces with both case studies. In Case 1, the initial phase of medical treatment is covered under the emergency medicine doctrine. However, as Winston becomes cognitively capable, he may be able to provide informed consent for medical treatment depending on the state in which the scenario takes place. Clearly, Winston’s parents, once notified, become the avenue through which consent can be provided. In Case 2, interpretation of the mature minor doctrine may authorize Samantha to provide consent for her surgical repair.

Clearly, two issues confront the medical professional dealing with these cases. It is of primary importance to determine if a medical emergency exists. More care can be provided, in the absence of parental consent, to the individual whose medical condition is truly an emergency than to the individual for whom medical care may be necessary for return to athletic participation. A review of state statutes and appellate rulings would support the notion that, with or without parental consent, Winston would be treated. The precise nature of the treatment, once the emergency has been stabilized is not well defined.

While the former is concise—consent is not a major issue—the latter presents several topics. One of the dilemmas with the mature minor doctrine is the determination of the age at which an individual has sufficient mental capacity to understand suggested medical procedures and be able to assess the risks versus the proposed benefits of the procedures. The JJSP suggests that an individual be 16 years of age or older. For treatment for mental disorders, the age of 14 is suggested, and, in many states, no lower limit is set for reproductive medical advice and treatment. Determining who constitutes a “mature minor” is as difficult in the courts as it is in society-at-large.\textsuperscript{1,10}

Another topic which is raised also relates to age of mental competence. Many states require high school athletes to sign an assumption of risk prior to participation in sports. If athletes can understand and assume the risk of participation in sport,\textsuperscript{11} can they also understand and assume the power to consent for medical procedures?

Finally, the mature minor doctrine often leaves a great deal of ambiguity regarding financial obligations for the medical care provided a minor. Implicit in many statutes is the assumption that payment for services will be rendered.\textsuperscript{1} This is not always the case. In Missouri Osteopathic Foundation v. Ott,\textsuperscript{12} a father was not held liable for charges incurred by his daughter for medical care for which he did not consent. The court stated that the Missouri statute clearly indicates that a parent must expressly agree to pay for services to be held financially liable.

Conclusion
Case 1 is clearly covered by the emergency medicine doctrine which states that, when parental consent cannot be obtained, necessary medical treatment is authorized. A host of other legal issues can be raised which are beyond the scope of this discussion. What is the role of a minor student athletic trainer in the provision of medical care to a minor patient? Does the school have any responsibility to provide trained medical personnel at all practices? The court in Montgomery v City of Detroit,\textsuperscript{13} a case brought by the parents of a student who died of a heart attack on the athletic field, failed to hold the school or school personnel liable for not having trained medical personnel covering athletic events. What is the purpose and scope of obtaining parental consent for medical care prior to an athletic season?

Case 2 is not a medical emergency. For the surgical correction of the shoulder subluxations, consent must be provided. The question in Case 2 is: “Who is authorized to provide this consent?” Unanswered questions are also present. “Who will pay for the procedure?” If Samantha’s parents do not want to consent to the surgery, can she, under the mature minor doctrine, go against their wishes?

When providing emergency medical care to minors, lack of parental consent does not limit the provision of necessary medical care to prevent damage to the life or health of a minor. When an emergency is not present, consent must be obtained. When the patient is a minor, the parent is the optimal consent-giver. However, the mature minor may be authorized to provide consent. Athletic trainers and other allied health practitioners who often find themselves dealing with a minor population should be familiar with emergency medicine and mature minor statutes in the states in which they are employed.

References
2. Ark CA §6-17-107.
3. Az RS §36-2206.
4. Az RS §44-133.
5. Cal Bus Prof C §2398.
7. Cal Ed C §76407.
8. Co RSA §19-1-104.
15. Va CA. §84-133.
17. Younts v. St. Francis Hospital, 469 Pac 2d 330.
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Abstract: The purpose of this study was to examine the salaries for entry-level positions in athletic training during the year 1992. An entry-level position was defined as an athletic trainer, certified by the National Athletic Trainers' Association (NATA), with no full-time paid employment experience. According to the "Placement Vacancy Notice" published by the NATA, there were 234 entry-level vacancies in the hospital/clinic, 135 with the college/university, and 58 at the high school setting. A survey was designed and mailed to the location of each of these 427 entry-level positions. Distribution of responses was 78 (33%), 55 (41%), and 23 (40%) for hospital/clinic, college/university, and high school, respectively. Overall, beginning salaries for entry-level athletic training positions were $23,108 (± $3,309) for a bachelor's degree and $25,223 (± $3,794) for a master's degree. A stipend ($4,219 ± $1,458) was included in most of the high school positions. Term of contract for high school was usually 10 months (10.2 ± 0.8 months), hospital/clinic was 12 months (11.9 ± 0.6 months), while the college/university varied from 9 to 12 months (10.8 ± 1.3 months). Further studies are recommended to establish salary norms and trends for entry-level positions so that athletic trainers will understand what monetary compensation is expected for their services.

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Results

Of the 427 entry-level positions published in the 1992 "Placement Vacancy Notice" by the NATA, there were 234 entry-level vacancies in the hospital/clinic, 135 with the college/university, and 58 at high schools. Distribution of responses was 78 (33%), 55 (41%), and 23 (40%) for hospital/clinic, college/university, and high school, respectively. Overall percentage of return was 36.5%. Anything less than 60% is suspect in the final analysis. Care should be taken when drawing conclusions from such a low return. Because of cost limitations, a self-addressed return envelope was not sent with each survey, however a return address label was enclosed. No other sources of athletic training vacancies were used for this study.

Methods

An entry-level position was defined as an athletic trainer, certified by the NATA, with no full-time paid employment experience. According to the "Placement Vacancy Notice" published at least once a month by the National Athletic Trainers' Association (NATA), there were 427 beginning position vacancies during the year 1992. Job descriptions are included in the vacancy notice. A survey was designed and mailed, after each monthly notice, to the location of those job descriptions which did not specify that experience was necessary. An address list was compiled and checked each month to determine new position vacancies. Only one survey was sent to a job site for each new vacancy. Because of monetary constraints, there was no follow-up survey. The survey was not coded individually. Identification of the origin of each survey was determined by either the person filling in the response for results of the study, the envelope letterhead return address, and/or the postmark on the envelope. I do not suggest this type of coding, but it was a simple way to identify each position for which survey was sent. The survey topics included: position available; compensation for bachelor's degree, master's degree, and stipend; term of contract; and NATA district. The overall return of the survey was only 36.5%. Anything less than 60% is suspect in the final analysis. Care should be taken when drawing conclusions from such a low return. Because of cost limitations, a self-addressed return envelope was not sent with each survey, however a return address label was enclosed. No other sources of athletic training vacancies were used for this study.
Table 1.—Entry Level Salaries According to Job Site and Position

<table>
<thead>
<tr>
<th>Position</th>
<th>Bachelor’s Degree</th>
<th>Master’s Degree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X ± SD</td>
<td>(n)</td>
</tr>
<tr>
<td>Hospital clinic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Athletic trainer</td>
<td>22,991 ± 1,467</td>
<td>(25)</td>
</tr>
<tr>
<td>Athletic trainer/HS</td>
<td>22,736 ± 2,239</td>
<td>(46)</td>
</tr>
<tr>
<td>College/university</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head athletic trainer</td>
<td>24,000</td>
<td>(1)</td>
</tr>
<tr>
<td>Athletic trainer/teacher</td>
<td>22,698 ± 4,194</td>
<td>(4)</td>
</tr>
<tr>
<td>Assistant athletic trainer</td>
<td>19,450 ± 2,710</td>
<td>(12)</td>
</tr>
<tr>
<td>High School</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Athletic trainer</td>
<td>22,117 ± 4,146</td>
<td>(4)</td>
</tr>
<tr>
<td>Athletic trainer/teacher</td>
<td>26,719 ± 4,230</td>
<td>(19)</td>
</tr>
</tbody>
</table>

degree, and $25,223 (± $3,794) for a position requiring a master’s degree.

All of the athletic trainer/teacher high school positions included a stipend ($4,219 ± $1,458) with the annual salary. The four athletic training positions which required no teaching assignment did not receive a stipend. College/university (n = 2) and hospital/clinic (n = 3) positions very seldom received a stipend as part of their salary. Term of contract for high school was usually 10 months (74%, 54/73; 10.2 ± 0.8 months (n = 73), hospital/clinic 12 months (96%, 53/55; 11.9 ± 0.6 months (n = 55)), while the college/university contract varied over 9 months (22%, 5/23), 10 months (25%, 6/23), and 12 months (49%, 11/23; 10.8 ± 1.3 months (n = 23)).

Table 2 shows the rank order of the mean beginning salaries from highest to lowest by NATA district according to bachelor’s degree and master’s degree. These salaries represent a combined job site and position; however, they do not take into account the cost of living by district. A listing of each state was not included in this study because of the low number of entry-level positions and responses from each individual state.

Discussion

As a director of an undergraduate athletic training program, I receive phone calls from both school and hospital/administrators concerning how much salary an athletic trainer should receive. I know of only one survey which indicated a range of salaries for athletic trainers. This survey may have indicated the athletic trainer’s salary in 1986, but what was the 1992 salary expectation of the entry-level student certified by the NATA?

If the information from this study is the trend of future job vacancies, then future certified athletic trainers need to understand that most of the job positions in which they may work will be at either the hospital/clinic or college/university.

Most of the job vacancies sited at the hospital/clinic setting require a high school assignment at a mean salary of $22,736 (±$2,239) for the bachelor’s degree, and a mean salary of $25,330 (±$2,930) for a master’s degree. Either a bachelor’s or master’s degree is sufficient to acquire a job at this setting. When comparing these salaries to the other job positions, one must remember that a stipend is usually not included in the annual salary and that this salary represents a 12-month contract.

Even though the high school setting had few job positions available in 1992, they recorded the highest beginning salaries. When the stipend is added to a beginning teacher’s salary, the salary increases substantially ($22,500 + $4,219 = $26,719 ± $4,230). This is very similar to the other bachelor’s degree salaries listed in Table 1, except for the college/university assistant athletic trainer position ($19,450 ± $2,710). According to the results, most high school positions had a 10-month contract. When this is taken into consideration along with the stipend, the best paid position for a beginning athletic trainer is at the high school with teaching responsibilities.

An entry-level position for the college/university setting normally requires a master’s degree. Even though Table 1 lists annual salaries with a bachelor’s degree, a master’s degree is recommended if a certified athletic trainer is pursuing these positions. The most common vacancy at the college/university setting was as an assistant athletic trainer at a mean salary of $22,858 (±$3,486). A number of people have expressed to me that the reason these salaries are so low is because they are used as a stepping stone to a head athletic training position or to professional sports. When reviewing the NATA “Placement Vacancy Notice,” I noticed that there were few positions available as the head athletic trainer.
at either the college/university level or in professional sports. The positions listed in Table 1 are beginning athletic training positions. Head athletic trainer positions had a mean salary of $26,565 (±$4,041), and athletic trainer/teacher positions a mean salary of $24,434 (±$4,247) at the college/university. If these are the positions that the assistant athletic trainer is pursuing, then the small increase in salary and large increase in job responsibilities may not be balanced. Remember that the term of contract for these positions varies from 9 to 12 months, with the most common at 12 months.

According to the latest Role Delineation Study,4 no matter what the setting of the athletic trainer’s practice, the professional responsibilities are basically the same. If the job responsibilities are the same, with the same certification exam given by the NATA-BOC, then why is there such a discrepancy in salary? Weidner7 had one answer to this discrepancy: “Many ATCs also are guilty of accepting embarrassingly low salaries.” Goetze2 raised the question: “Are we a profession or a trade?” He stated further: “If we do not limit the number of eligible candidates, thus insuring a highly qualified and readily employable professional,” we will be “negligent by allowing someone to train in a profession where only a small percentage find a decent paying (family wage) job.”2 I agree with Weidner7:

“The time has come for the NATA to help its members negotiate better salaries by establishing standards and guidelines. The NATA should list recommended starting salaries for the various settings in which ATCs are now employed. The NATA should consider conducting scientifically based salary surveys and sharing the results with its members.”

References
Job Marketability Survey for Athletic Trainers in Selected Midwestern States

Judith Sexton, PhD
Kurt Schmoldt, MS, ATC
Helen Miles, MS

Abstract: This study was conducted to determine job availability for athletic trainers in school and/or clinic settings in western Kansas, western Nebraska, western Oklahoma, and eastern Colorado. A survey was sent to 109 physical therapy (PT) clinics and 194 public schools to determine the major factors associated with job marketability. Of the 194 questionnaires mailed to the public schools, 119 were returned for a 61% response rate. Of the 109 questionnaires mailed to PT clinics, 57 were returned for a 52% response rate. Very few school districts (13%) hired their own trainer due to financial restrictions; therefore, the National Athletic Trainers’ Association (NATA) athletic trainer would increase his/her likelihood of being hired if he/she was also teacher-certified. Most of the clinics responding would hire an NATA-certified athletic trainer if that individual was also licensed as a physical therapist, whereby, the trainer without PT licensure could be used for outreach programs for the local high schools. Essential factors identified by both the public school and clinic personnel for increasing the marketability of athletic trainers were: 1) NATA certification, 2) acquisition of an additional certification such as a teaching endorsement or a PT degree, and 3) willingness to provide services jointly to the schools and/or clinic with either being the primary hiring agent.

The field of athletic training has grown measurably during the past several years. Currently, there are approximately 10,000 certified athletic trainers and each year about 1400 newly certified athletic trainers join the professional ranks (NATA Office, September 1993). Not only has there been an increase in the number of individuals certified, but also an increase in the types of employment settings available to athletic trainers. Athletic trainers obtain employment at the secondary school level, the collegiate and professional ranks, and in sports medicine clinics. According to Powell,5 approximately 10% of the nation’s high schools employ certified athletic trainers. At the collegiate and professional ranks, the NATA3 reports there is one certified athletic trainer for every 5500 athletes. Certified athletic trainers are concerned with their marketability, and the increase in the number of sports medicine clinics has provided graduates with additional options for employment. The majority of trainers are now employed in sports medicine clinics or industry.1 Some new graduates are still interested in teaching and serving as athletic trainers in the public school setting. However, economic restraints of many public schools have resulted in minimal advertising for athletic trainers.7

This study was conducted to determine job availability for athletic trainers in the school and clinic settings in selected sections of a four-state area: Kansas, Nebraska, Oklahoma, and Colorado.

Methods

We designed an information sheet summarizing the duties and functions of athletic trainers in various settings. We then developed two questionnaires to determine the job market for athletic trainers in western Kansas, western Nebraska, western Oklahoma, and eastern Colorado.

The first questionnaire was developed to gain information concerning the need for athletic trainers in the physical therapy clinic setting. The instrument contained 16 questions. The questionnaire, cover letter, and an athletic training information sheet were then mailed to 109 PT clinics compiled from the Medical Health Information Directory.2

The second questionnaire was developed to gain information concerning the need for athletic trainers in the public school setting. The instrument contained 20 questions. The questionnaire, a cover letter, and an athletic training information sheet were then mailed to 194 school districts compiled from each State Department of Education’s list of county superintendents of schools.4

Results

Of the 109 surveys distributed to PT Clinics, 57 (52%) completed surveys were returned. Distribution of responses by state was: Kansas, 18 (32%); Nebraska, 11 (19%); Colorado, 8 (14%), and Oklahoma, 20 (35%).

Questions that were based on unconditional responses (n = 57) resulted in the responses presented in Table 1. Areas identified by the responding clinics as having the great-
Count them...

#1 **Tear-light** Tape
Lightweight Elastic Adhesive Tape
- 130622 2” x 5 yds.
- 130623 3” x 5 yds.
- 130626 1½” x 7½ yds.
- 130632 2” x 7½ yds.
- 130633 3” x 7½ yds.

#2 **Mtape**
Zinc Oxide Trainers Tape
- 130104 1” x 10 yds.
- 130105 1½” x 15 yds.
- 130106 2” x 15 yds.

#3 **MtapeXTRA**
Porous Zinc Oxide Trainers Tape Extra Strength
- 130162 1½” x 15 yds.
- 130163 2” x 15 yds.

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The needs assessment survey sent to 194 secondary schools in a 4-state area resulted in 119 responses (61%). Percentage distribution of responses by state was: Kansas, 62%; Colorado, 22%; Nebraska, 13%; and Oklahoma, 3%.

Questions based on unconditional responses (n = 119) resulted in the replies presented in Table 3. Conditional responses are presented separately in either a table or narrative format. Results of the two questions dependent upon the condition that the school district offered an athletic/sports program (n = 108) are presented in Table 4.

When asked to identify districts for potential sharing, 37 (71%) indicated surrounding schools; 3 (6%) were willing to share with anyone; 1 (2%) was unsure; and 11 (21%) did not respond (n = 52). School districts were asked to list the top choices or needs for teacher certification areas. The top ranking endorsement needs are presented in Table 5. Schools were allowed to list more than one choice, but had to list choices in order of preference (n = 288).

Those school districts currently employing an athletic trainer (n = 14) indicated the approximate stipend for this position as: $1000 to $5000 = 5 (36%); $10,000 to $15,000 = 1 (7%); $15,000 to $20,000 = 1 (7%); and 7 school districts (50%) did not respond to this question. Schools that currently provided the services of an athletic trainer not certified by the NATA (n = 4) indicated that these services were provided by a student (50%), an EMT (25%), or some other individual (25%). School districts not currently employing an athletic trainer (n = 81) were asked whether they would hire a trainer if one were available. Replies indicated that 18 (22%) would hire, 51 (63%) would not hire, 8 (10%) were unsure, and 4 (5%) did not respond. For those school districts that would consider hiring a NATA-certified athletic trainer (n = 23), 1 school (4%) would hire full time; 5 schools (22%) would hire part time, and 17 (74%) would hire full time with teaching duties. School districts not currently using the services of an athletic trainer (n = 83) indicated the following procedures: MD at practice, 1 (1%); MD at games, 3 (4%); ambulance at games, 7 (8%); EMT, 5 (6%); other, 66 (80%); and no response, 1 (1%). The “other” response included the common practice of having the coach or assistant coach perform the athletic trainer duties.

Discussion

Of the school districts responding to the questionnaire, 91% offered an athletic/sports program, but only 14 districts (13%) reported that they currently used an athletic trainer in their program. From these 14 districts that are using an athletic trainer, only 10 districts (9%) hired
Table 3.—Unconditional Response Questions (n = 119)

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>No Response</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>School district offer an athletic/sports program?</td>
<td>108 (91%)</td>
<td>10 (8%)</td>
<td>1 (1%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Prefer hiring an athletic trainer who is teacher certifiable?</td>
<td>97 (82%)</td>
<td>6 (5%)</td>
<td>16 (13%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Would share a NATA-certified trainer with another school district?</td>
<td>52 (44%)</td>
<td>45 (38%)</td>
<td>12 (10%)</td>
<td>10 (8%)</td>
</tr>
<tr>
<td>Would hire NATA-certified trainer who is not teacher-certified?</td>
<td>31 (26%)</td>
<td>74 (62%)</td>
<td>6 (5%)</td>
<td>8 (7%)</td>
</tr>
<tr>
<td>Financially feasible to hire an athletic trainer?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-time</td>
<td>11 (9%)</td>
<td>85 (71%)</td>
<td>19 (16%)</td>
<td>3 (3%)</td>
</tr>
<tr>
<td>Part-time</td>
<td>1 (1%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Interested in a sportsmedicine workshop?</td>
<td>92 (77%)</td>
<td>16 (14%)</td>
<td>7 (6%)</td>
<td>4 (3%)</td>
</tr>
</tbody>
</table>

Table 4.—Responses of School Districts Offering an Athletic/Sports Program

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>No Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is providing for sports medicine care considered a critical issue by your school district?</td>
<td>68 (63%)</td>
<td>38 (35%)</td>
<td>2 (2%)</td>
</tr>
<tr>
<td>If you employ an athletic trainer is the position . . .</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-time</td>
<td>0 (0%)</td>
<td>6 (46%)</td>
<td>3 (23%)</td>
</tr>
<tr>
<td>Part-time</td>
<td>6 (46%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Teaching</td>
<td>4 (31%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Are the trainer(s) certified by the NATA?</td>
<td>8 (57%)</td>
<td>4 (29%)</td>
<td>2 (14%)</td>
</tr>
</tbody>
</table>

their own trainer or had a trainer on staff. Available employment with a school district is increased with NATA certification, a teaching certification, and the willingness to share athletic training duties with another school district. Financial constraints prevented school districts from hiring an athletic trainer; therefore, multiple duty/multiple certification qualifications were important to high school employment.

About 80% of the clinics responding indicated that a need exists for athletic trainers in their area, whereas just over 50% of the clinics were currently offering a sports rehabilitation program as part of their service package. In conjunction with these responses, the following factors were identified by this survey as having a strong impact on job potential in the clinic setting: 1) most clinics would prefer having an NATA-certified athletic trainer also possessing Physical Therapy certification, 2) expansion and hiring potential was greatest in clinics that could provide outreach programs to local high schools with a strong inclination for sharing services with another facility, and 3) high schools were strongly identified as needing athletic trainers.

Table 5.—Athletic Trainer-Teaching Certification Needs (n = 288)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Certification Endorsement</th>
<th>Responses</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PE/Health</td>
<td>59</td>
<td>20%</td>
</tr>
<tr>
<td>2</td>
<td>Science</td>
<td>39</td>
<td>14%</td>
</tr>
<tr>
<td>3</td>
<td>Math</td>
<td>35</td>
<td>13%</td>
</tr>
<tr>
<td>4</td>
<td>No response</td>
<td>34</td>
<td>12%</td>
</tr>
<tr>
<td>5</td>
<td>Social Science</td>
<td>26</td>
<td>9%</td>
</tr>
<tr>
<td>6</td>
<td>English/Language Arts</td>
<td>21</td>
<td>7%</td>
</tr>
<tr>
<td>7</td>
<td>Any . . . depends</td>
<td>15</td>
<td>5%</td>
</tr>
<tr>
<td>8</td>
<td>Elementary</td>
<td>10</td>
<td>3%</td>
</tr>
<tr>
<td>9</td>
<td>All others combined</td>
<td>49</td>
<td>17%</td>
</tr>
</tbody>
</table>

Conclusions

From a combination of factors identified by both the public school and clinic settings, the following attributes should serve to increase the marketability of athletic trainers. The job-seeking athletic trainer should have the NATA certification, attempt to obtain additional certification (teaching endorsement, physical therapy, or other related area), and be aggressive and creative in establishing a job niche, such as the potential to share services between clinics and public schools. Findings from this survey regarding employment in the school setting are similar to information obtained from a public school survey administered by Prentice and Mishler. We concluded from both surveys that the athletic trainer desiring employment in this setting should have the following: NATA certification, a teaching major in physical education, math, or science, and a secondary teaching endorsement.

References

2. Backus K. Medical and Health Information


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- Improves productivity and keeps people at work
- Economical to dispense at pennies per dose
- Complete line for best treatment
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<td>300 Tablets (150x2)</td>
<td>9.25</td>
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<td>36.80</td>
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</tr>
<tr>
<td>ULTRAPRIN</td>
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<tr>
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</tr>
<tr>
<td>VALORIN SUPER</td>
<td>300 Tablets (150x2)</td>
<td>17.80</td>
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</table>

Liquids & Ointments

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</tr>
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<td>LAURO EYE WASH</td>
<td>4 oz Bottle</td>
<td>6.75</td>
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<tr>
<td>OBTUNDIA ANTISEPTIC</td>
<td>1/2 oz Dropper Bottle</td>
<td>4.45</td>
</tr>
<tr>
<td>OBTUNDIA CALAMINE</td>
<td>2 1/2 oz Spray Can</td>
<td>7.65</td>
</tr>
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<td>36 x .11 oz Packets</td>
<td>18.50</td>
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<tr>
<td>SANCIIA SILICONE</td>
<td>36 x .11 oz Packets</td>
<td>18.50</td>
</tr>
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<td>SILEXIN SYRUP</td>
<td>24 x 3/4 oz Tubes</td>
<td>43.40</td>
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<td>2 oz Tube</td>
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</tr>
<tr>
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<td>5.25</td>
</tr>
<tr>
<td>SILEXIN SYRUP</td>
<td>12 x 1 1/2 oz Bottles</td>
<td>29.80</td>
</tr>
<tr>
<td>SILEXIN SYRUP</td>
<td>16 oz Bottle</td>
<td>17.90</td>
</tr>
<tr>
<td>SILEXIN SYRUP</td>
<td>36 x 1/4 oz Tubes</td>
<td>46.70</td>
</tr>
<tr>
<td>SILEXIN SYRUP</td>
<td>16 oz Jar</td>
<td>29.80</td>
</tr>
<tr>
<td>SILEXIN SYRUP</td>
<td>1 oz Tube</td>
<td>5.25</td>
</tr>
</tbody>
</table>

* Formerly MIGRANOL
Prevalence of Anabolic Steroid Use Among Illinois High School Students

Gregory L. Gaa, ATC/R, CSCS
Edwin H. Griffith, PhD
Bernard R. Cahill, MD
Leslye D. Tuttle, ATC/R

Abstract: This study was conducted to quantify anabolic steroid use in Illinois, investigate student knowledge and perception of anabolic steroid use, and identify characteristics of the anabolic steroid user. We surveyed 3047 freshman and senior high school students from 38 high schools, randomly selected from three school enrollment sizes and five geographic locations, using a six-page anonymous questionnaire. Anabolic steroid use was reported by 58 (1.9%) of the participants, 44 of 1477 (3%) males and 14 of 1562 (0.9%) females. Thirty-four of 1679 (2%) freshmen and 24 of 1366 (1.8%) seniors reported use. Anabolic steroids were used in all possible school enrollment sizes and geographic locations (matrix cells). Four (7%) of the users reported starting at age 10 or younger. A teacher/coach was reported as a primary source by 8 (14%) of the users, as well as identified by 11 (19%) of the users as the individual they knew using anabolic steroids. It appears that anabolic steroids are being introduced to students in elementary and junior high schools, and that teachers/coaches are actively involved in their use.

Throughout the past decade, several athletes have admitted using anabolic steroids; however, the first reported use in athletics was in 1954 by the Russians.5,13,17 There is evidence that anabolic steroid use is no longer confined to elite athletes; it has become increasingly popular among high school students.1-3,7-11,15,16,18,21 Several studies1-3,7-11,15,16,18,21 have attempted to document the prevalence of anabolic steroid use among high school students in the United States with use reported between 1.1%5 and 11.1%9 in males, and between 0.4%8 and 2.7%15 in females. All of the studies1-3,7-11,15,16,18,21 used unidentified self-report surveys for data collection.

In literature specific to Illinois, Terney and McLain16 reported 4.4% anabolic steroid use among surveyed students in a suburban Chicago high school in 1988, with 6.5% use among surveyed males and 2.5% use among surveyed females. A 1990 Youth Survey by the Addictions Research Institute of the Illinois Department of Alcoholism and Substance Abuse15 reported anabolic steroid use to be 5.7% by males and 2.7% by females surveyed in grades 7 through 12.

We undertook this study to better define the prevalence of anabolic steroid use, investigate student knowledge and perception of anabolic steroid use, and identify characteristics of the anabolic steroid user among Illinois high school students. This is the first statewide study categorizing use by school enrollment size and geographic location.

Methods

The survey consisted of a six-page anonymous questionnaire, designed to elicit descriptive information about the perception and prevalence of anabolic steroid use, and characteristics of the anabolic steroid user. Pages 1 to 3 of the questionnaire (completed by all participants) dealt with demographics, personal characteristics, student perception, knowledge, and actual use of anabolic steroids. Anabolic steroid users were identified by affirmative responses to questions regarding current or previous use of anabolic steroids. Self-identified users then were directed to complete pages 4 and 5, which consisted of questions regarding personal use patterns. Nonusers completed page 6, which consisted of questions investigating their reasons for not using anabolic steroids and other drugs.

Study participants were freshman and senior students randomly selected from a stratified random sample of Illinois High School Association 1990 to 1991 member schools. Freshman and senior students were used to compare steroid use of those entering high school and those who were near the completion of high school. For a school to be selected for possible inclusion into this study, the school had to offer at least football and two other male sports and three female sports. The schools meeting this criterion were categorized by individual enrollment size according to the 1990 Illinois High School Association football playoff pairings. Enrollment size matrix cells included: Small (0 to 417), Moderate (418 to 1217), Large (1218 and up). Schools were further categorized by geographic location to include: Chicago, Suburban, Northwest, Central, and Southern. This gave us 15 matrix cells.

Gregory Gaa is Coordinator of Outreach Services at Great Plains Sports Medicine and Rehabilitation Center in Peoria, IL. Edwin Griffith is Superintendent of Peoria District 150 Schools. Bernard Cahill is Medical Director of Great Plains Sports Medicine and Rehabilitation Center. Leslye D. Tuttle is an athletic trainer in Peoria.
Using a table of random numbers,4 we randomly selected three primary and three alternative schools from each matrix cell for possible participation within this study. The primary schools’ principals were contacted by telephone by the senior author, regarding their participation in the study. Alternate schools were contacted as needed in the order selected. If three schools out of the primary and alternative schools previously selected did not agree to participate, an additional three primary and alternate schools were randomly selected and contacted. The selection of schools continued until three schools per matrix cell agreed to participate or until all possible schools were contacted. To meet sample size, staffing, and financial concerns, three schools were used per matrix cell.

To obtain a 90% confidence level ($p = .05$), we determined that 300 students were needed from each matrix cell (school enrollment size and geographic location).34 To select potential participants, we requested freshman and senior enrollment lists or identification numbers from all participating schools. Using a table of random numbers,4 50 freshman and 50 seniors (plus 10 alternates from each class) were selected to participate. The ten alternates were selected and used as needed for absences that occurred on the day of the survey. A list of the identified individuals was returned to the schools.

During the Spring of 1991, we (GLG or LDT) personally conducted the survey at each school on a specified date. This was designed to create a nonthreatening survey collection atmosphere by using a trained nonschool examiner. All students voluntarily participated, and we assured them that their participation would be anonymous.

Of 127 schools contacted for possible participation, 38 participated and 89 declined. Lack of time was the primary reason given by 31 (35%) of the schools for refusing to participate. Twenty schools (22%) gave no reason for not participating, while 18 (20%) would not pull students from class (which was necessary for the requirements of random selection of students). All geographic locations and school enrollment sizes (matrix cells) were represented, except the small Chicago cell where no schools met the predetermined study criteria. Also, all large school matrix cells lacked one school except the central region. However, only freshman were surveyed in one large school in the central region. Within the Northwest and Southern large school cells, all possible schools within the possible population of schools were exhausted. In the suburban matrix cell, a moderately sized school with an enrollment of 542 was selected and placed into the small cell after all schools in the cell were exhausted. There were five schools without 50 freshman and 50 seniors, and one school without 50 seniors within the sample of schools surveyed. In these six schools, all respective freshmen and senior students were selected for possible participation.

A total of 3750 surveys were distributed to 50 freshman and 50 senior students from each of 37 different schools and 50 freshman from one school; 3054 were completed. Of those, 7 were discarded: 4 were identified as corticosteroid users and 3 were removed for unidentifiable responses. Participation numbered 3047 out of 3750 (81%).

**Results**

Fifty-eight (1.9%) students indicated that they were using or had used anabolic steroids; of these, 32 (55%) reported that they were currently using. Table 1 identifies anabolic steroid use by freshman and senior students in each matrix cell (geographic location and school enrollment size). Forty-four (3%) of the males reported use, while 14 (0.9%) females reported use. Forty-six (79%) of the users reported knowing someone currently or previously using anabolic steroids, as did 993 (33%) of the nonusers. Table 2 reflects anabolic steroid users’ and nonusers’ perceptions of anabolic steroid use in their respective class (freshman/senior). Individual cells were not compared, because the user group is small and the unequal numbers in the matrix cells made them statistically incomparable.

**Anabolic Steroid User Characteristics**

Within this study, several characteristics of the anabolic steroid user were identified. Thirty-seven (64%) of the anabolic steroid users reported that they were athletes. An athlete was considered to be one who participated on a school-sponsored athletic team during the 1990 to 1991 school year. Football athletes accounted for the greatest number of athletic users (24 (65%)), while both wrestling and basketball participation were identified by 13 (35%) of the athletic users. Table 3 shows participation by anabolic steroid user athletes on school-sponsored athletic teams.

Weight lifting/body building was the most frequently identified sport by 37 (64%) of the anabolic steroid users participating in recreational sports. Basketball was cited by 20 (34%) and swimming by 16 (28%) of the recreational sport participants.

Twelve (21%) of the anabolic steroid users started using at age 15, followed by 11 (19%) at age 14. However, 4 (7%) of the anabolic steroid users reported that they started at age 10 or younger. Eleven (19%) of the users reported using one cycle (time when drug is being used) during their lifetime, while 10 (17%) reported eight or more. Fifteen (26%) anabolic steroid users reported stacking their steroids, while 24 (41%) reported their average length of cycle to be 1 to 5 weeks. The main reason for using anabolic steroids was to enhance performance (13 (22%)), followed by improving appearance (9 (16%)), and treating a sports injury (8 (14%)).

Table 4 lists sources for obtaining steroids. Nonphysician sources (commonly referred to as the black market) were the primary sources, identified by 42 (72%) of the users. Specific sources include teammate/friend (17 (29%)), teacher/coach (8...
Table 1.—Anabolic Steroid Use by Matrix Cell (Geographic Location and School Enrollment Size). Number of Users/Total Number of Students Surveyed in That Cell (Percent of Users Within that Cell)

<table>
<thead>
<tr>
<th>Geographic Location</th>
<th>School Size</th>
<th>Total</th>
<th>Total students</th>
<th>Total students</th>
<th>Total students</th>
<th>Total students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Small</td>
<td>Moderate</td>
<td>Large</td>
<td>Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total students</td>
<td>NA</td>
<td>2/188 (1.1%)</td>
<td>1/109 (0.9%)</td>
<td>3/297 (1.0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshman</td>
<td>NA</td>
<td>1/100 (1.0%)</td>
<td>0/64 (0.0%)</td>
<td>1/164 (0.6%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior</td>
<td>NA</td>
<td>1/88 (1.1%)</td>
<td>1/45 (2.2%)</td>
<td>2/133 (1.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suburban</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total students</td>
<td>2/221 (0.9%)</td>
<td>7/290 (2.4%)</td>
<td>7/168 (4.2%)</td>
<td>16/679 (2.4%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshman</td>
<td>1/118 (0.8%)</td>
<td>3/153 (2.0%)</td>
<td>1/95 (1.1%)</td>
<td>5/366 (1.4%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior</td>
<td>1/103 (1.0%)</td>
<td>4/137 (2.9%)</td>
<td>6/73 (8.2%)</td>
<td>11/313 (3.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northwest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total students</td>
<td>7/249 (2.8%)</td>
<td>2/287 (0.7%)</td>
<td>1/171 (0.6%)</td>
<td>10/707 (1.4%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshman</td>
<td>3/133 (2.3%)</td>
<td>2/148 (1.4%)</td>
<td>1/91 (1.1%)</td>
<td>6/372 (1.6%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior</td>
<td>4/116 (3.4%)</td>
<td>0/138 (0.0%)</td>
<td>0/80 (0.0%)</td>
<td>4/334 (1.2%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total students</td>
<td>4/267 (1.5%)</td>
<td>1/239 (0.4%)</td>
<td>9/215 (4.2%)</td>
<td>14/721 (1.9%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshman</td>
<td>3/151 (2.0%)</td>
<td>0/130 (0.0%)</td>
<td>8/143 (5.6%)</td>
<td>11/424 (2.6%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior</td>
<td>1/116 (0.9%)</td>
<td>1/109 (0.9%)</td>
<td>1/72 (1.4%)</td>
<td>3/297 (1.0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southern</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total students</td>
<td>9/244 (3.7%)</td>
<td>3/275 (1.1%)</td>
<td>3/131 (2.3%)</td>
<td>15/650 (2.3%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshman</td>
<td>7/142 (4.9%)</td>
<td>2/145 (1.4%)</td>
<td>2/69 (2.9%)</td>
<td>11/356 (3.1%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior</td>
<td>2/101 (2.0%)</td>
<td>1/130 (0.8%)</td>
<td>1/62 (1.6%)</td>
<td>4/293 (1.4%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total students</td>
<td>22/981 (2.2%)</td>
<td>15/1279 (1.2%)</td>
<td>21/794 (2.6%)</td>
<td>58/3047 (1.9%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshman</td>
<td>14/544 (2.6%)</td>
<td>8/676 (1.2%)</td>
<td>12/462 (2.6%)</td>
<td>34/1682 (2.0%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior</td>
<td>8/436 (1.8%)</td>
<td>7/602 (1.2%)</td>
<td>9/332 (2.7%)</td>
<td>24/1370 (1.8%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Discrepancies in freshman and senior students to total students is due to nonresponses.

The prevalence of anabolic steroid use was present in all possible matrix cells (school sizes and geographical locations) within this study. In an attempt to obtain the most accurate randomized sample, we used a two-step random selection design of schools and students. The honesty of the participants in this study is unknown, and it is possible that participants under-reported or over-reported their anabolic steroid use, although we attempted to create a nonthreatening testing environment by using a trained nonschool examiner and an anonymous survey.

Throughout the administration of the survey, unexpected circumstances may have contributed to either under-reporting or over-reporting of results. First, only 38 (30%) of the selected schools participated in the study. This included the absence of 4 schools from the large school matrix cells. Second, 81% student participation may contribute to under-reporting or over-reporting. This is lower than expected since alternate participants were selected to compensate for absences. Lastly, it was reported by 46 (79%) of the anabolic steroid users and 99 (33%) of the nonusers that they knew someone currently or previously using anabolic steroids for other than medical purposes. Also, 54 (93%) of the anabolic steroid users and 216 (72%) of the nonusers estimated there was some use of anabolic steroids by their classmates (freshman/senior). It is possible that several classmates knew the same user within the study, although this is very unlikely and the anecdotal information is significantly higher than reported individual use. Since the reported knowledge of anabolic steroid use by students within this study is several times higher than the actual reported individual use, it may be concluded that some degree of under-reporting occurred in this study.

This study did produce results similar to Terney and McLain’s study when singling out the suburban large school matrix cell. This school within our study would have been placed into the large suburban cell. This study reported 4.2% use within the suburban large school cell, while Terney and McLain reported 4.4% use within their study.

Anabolic steroid use by freshman students was slightly greater than senior students. This is consistent with findings by Terney and McLain, who also reported use by freshman slightly greater than seniors. With the reported 1.8% lifetime use of anabolic steroids by eighth graders in a national study by Johnston et al., the reported use of anabolic steroids by freshman in this study and four who reported starting at age 10 or younger suggests that anabolic steroids are being introduced and used at the elementary and junior school levels.

Discussion
The prevalence of anabolic steroid use as indicated within this study is lower than most previously reported studies, although anabolic steroid use was present in all possible matrix cells (school sizes and geographical locations) within this study. In an attempt to obtain the most accurate randomized sample, we used a two-step random selection design of schools and students. The honesty of the participants in this study is unknown, and it is possible that participants under-reported or over-reported their anabolic steroid use, although we attempted to create a nonthreatening testing environment by using a trained nonschool examiner and an anonymous survey.

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- M chest (38" - 42") biceps (13" - 15")
- L chest (42" - 46") biceps (14" - 17")
- XL chest (over 46") biceps (over 15")

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Table 2.—Anabolic Steroid Users’ and Nonusers’ Perceptions of Anabolic Steroid Use by Their Classmates (Freshman/Senior)

<table>
<thead>
<tr>
<th>Estimated Number of Classmates Who Use or Have Used Steroids</th>
<th>Steroid User</th>
<th>Nonuser</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>0</td>
<td>3</td>
<td>5.2%</td>
</tr>
<tr>
<td>1–10</td>
<td>21</td>
<td>36.2%</td>
</tr>
<tr>
<td>11–25</td>
<td>18</td>
<td>31.0%</td>
</tr>
<tr>
<td>26 or more</td>
<td>15</td>
<td>25.9%</td>
</tr>
</tbody>
</table>

Total of percentages do not equal 100% due to nonresponses.

high school level. This is a significant concern, since documented side effects include premature closure of the growth plates and virilizing side effects in adolescents.6,12,13,19,20 These data suggest that anabolic steroid education should be directed toward elementary and junior high school students.

Alarmingly, 21 (36%) of the anabolic steroid users were school nonathletic participants, defined as not participating on a school-sponsored athletic team during the 1990 to 1991 school year. This is similar to findings by Buckley et al2 who found that 35.2% of the users did not intend to participate in a school-sponsored activity. Others have reported school nonathletic anabolic steroid users at 16% (15/94)16 and 26% (7/27).21 Among recreational sports steroid-user participants within this study, 37 (64%) identified weight lifting/body-building as their most common activity. This is a concern, since many school nonathletes do not lift weights in a “controlled” or supervised school environment, and are exposed to anabolic steroid users and dealers. Since over one third of the anabolic steroid users are nonathletes, it is essential the entire student population receive anabolic steroid education, not just athletes.

Among athletes, football players and wrestlers were expected to be the most prevalent users.2,16 However, results from this study indicate that use among basketball players is equal to that of wrestlers. Anabolic steroid use was also reported in several other sports. This suggests that adolescents in all sports feel that anabolic steroids will be beneficial. Nearly 20% of the users used only one cycle (time when the drug is being used) during their lifetime, while nearly another 20% used eight or more cycles. This may indicate that 20% are experimental users, while 20% are habitual users. The main reason for using anabolic steroids as reported in this study is consistent with results from Buckley et al.2 Performance enhancement is the most prevalent reason, followed by improved appearance, and treatment of a sports injury.

The primary source for steroids was identified as the black market, or nonphysician, source. Black market distribution of anabolic steroids is of concern, since there is no regulation on purity. Also, it allows for easy access of anabolic steroids and is illegal.

The reported involvement of using steroids, stimulating interest, and suggesting their use by a teacher/coach as indicated within this study is alarming, since anabolic steroids are a nationally controlled substance and such practices are unethical. Teachers and coaches are supposed to be role models for adolescents and are supposed to discourage the use of drugs. As reported in this study, the influence of suggesting anabolic steroid use by a teacher/coach may stem from an emphasis on winning and/or misinterpreted information by the athlete, such as teachers/coaches telling athletes to gain weight or bulk up during the off-season, without any intended reference to anabolic steroid use. Teachers/coaches should set goals that are achievable and be direct on measures to accomplish them.

Table 3.—Participation by Anabolic Steroid User Athletes on School-Sponsored Athletic Teams

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Football</td>
<td>24</td>
<td>64.9</td>
</tr>
<tr>
<td>Basketball</td>
<td>13</td>
<td>35.1</td>
</tr>
<tr>
<td>Wrestling</td>
<td>13</td>
<td>35.1</td>
</tr>
<tr>
<td>Baseball/softball</td>
<td>11</td>
<td>29.7</td>
</tr>
<tr>
<td>Volleyball</td>
<td>9</td>
<td>24.3</td>
</tr>
<tr>
<td>Track/cross country</td>
<td>8</td>
<td>21.6</td>
</tr>
<tr>
<td>Hockey</td>
<td>6</td>
<td>16.2</td>
</tr>
<tr>
<td>Swimming</td>
<td>5</td>
<td>13.5</td>
</tr>
<tr>
<td>Soccer</td>
<td>5</td>
<td>13.5</td>
</tr>
<tr>
<td>Other</td>
<td>9</td>
<td>24.3</td>
</tr>
</tbody>
</table>

Total of percentages equal more than 100% because some athletes participated in more than one sport.

The involvement of a teacher/coach in suggesting or aiding the use of anabolic steroids must be stopped. Anabolic steroid education for teachers/coaches should be required. If miscommunication is a causative factor, then teachers and coaches should be more direct in communicating with their students and athletes. Also, if a teacher/coach is found to be supplying anabolic steroids, swift legal action must be taken.

With reports of anabolic steroid use at early ages, further research should be conducted to investigate the prevalence of use in elementary and junior high schools. Also, further research should be conducted to investigate the role of the teacher/coach in the use and supply of anabolic steroids.

Table 4.—Primary Source for Obtaining Steroids

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friend/teammate</td>
<td>17</td>
<td>29.3</td>
</tr>
<tr>
<td>Teacher/coach</td>
<td>8</td>
<td>13.8</td>
</tr>
<tr>
<td>Physician/pharmacist/vet</td>
<td>7</td>
<td>12.1</td>
</tr>
<tr>
<td>Black market</td>
<td>6</td>
<td>10.3</td>
</tr>
<tr>
<td>Health club staff</td>
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<td>3.5</td>
</tr>
<tr>
<td>Mail order</td>
<td>2</td>
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<td>Parent/family</td>
<td>2</td>
<td>3.5</td>
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<tr>
<td>Other</td>
<td>5</td>
<td>8.6</td>
</tr>
</tbody>
</table>

Total percentages do not equal 100% due to surveys left unanswered.
Acknowledgments

Financing was provided by a pass-through grant from the Illinois Department of Alcoholism and Substance Abuse to the Illinois State Board of Education.

We would like to thank Jeff Sunderlin, Ron Vlasary, and Susie Morrison for their assistance in obtaining funding; Melinda Flegel for her assistance in editing of the final report and this paper; and, finally, the students in Illinois for their participation.

References

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Effects of Ankle Braces Upon Agility Course Performance in High School Athletes

Mark R. Beriau, MS, ATC
William B. Cox, BS, ATC
James Manning, PhD, ATC

Abstract: The purpose of this study was to compare the effects of wearing the Aircast™ Sports Stirrup, Aircast™ Training brace, Swede-O™ brace, and DonJoy™ Ankle Ligament Protector while running an agility course. Eighty-five high school athletes with no history of ankle injury and no experience in wearing any ankle support served as subjects. Each subject participated in four separate testing sessions. During sessions 1 and 4, subjects ran the agility course under the control (unbraced) conditions. Sessions 2 and 3 consisted of randomly wearing the ankle braces while running the agility course. A questionnaire concerning support, comfort, and restriction was completed by each subject after wearing each of the braces. An analysis of variance (ANOVA) with repeated measures revealed that a significant difference existed between the agility times. Tukey's post hoc test showed the only difference was between the DonJoy Ankle Ligament Protector and the Aircast Training brace. We concluded: 1) there is limited practical performance effect upon agility while wearing an ankle brace; and 2) an athlete's perceived comfort, support, and performance restriction are contributing factors that may directly influence the effectiveness of ankle bracing.

Ankle sprains continue to be a leading injury of many of today's athletes. External ankle support is generally accepted as a preventive practice for these injuries. Over the years, adhesive taping has been considered the standard method of ankle support. However, ankle bracing has been introduced as an alternative to this established standard, based upon comparisons of supportive quality and economical benefits. The supportive quality of semirigid and lace-up design braces has been reported as comparable to that of tape.

While the supportive quality of braces has been examined in several studies, few have addressed performance impedance, which can be attributed to the wearing of ankle braces. Despite limited examination of the effects of braces on athletic skills, we have found that many athletes, coaches, and health care professionals have a personal perception that ankle braces restrict performance. Therefore, we designed a study to: 1) compare the times required to run an agility course while wearing the Aircast™ Sports Stirrup, the Aircast™ Training brace, the Swede-O™ brace, and the DonJoy™ Ankle Ligament Protector; and 2) compare the levels of perceived support, comfort, and performance restriction reported by the athletes while wearing each of the ankle braces.

Methods

Eighty-five high school athletes (64 males, 21 females; 15.9 ± 1.2 yr) volunteered as subjects. Informed consent and memorandum forms were completed by both subjects and their parents before any data were collected. Limiting criteria for all subjects consisted of: a) no prior history of an ankle injury during the 6 months before testing; and b) no prior experience in wearing any type of ankle support.

Data collection involved four separate testing sessions. Session 1 involved: a) the explanation of the experimental protocol; b) the running of two familiarization trials of the agility course (Fig 1); and c) the running of two timed agility trials under the control (unbraced) condition.

The created agility course can be used on any gymnasium floor that has a standard high school/collegiate basketball key. The course incorporates forward and backward running, lateral shuffling, and directional changes. These are all skills that are commonly used for participation in most team sports played on fields or gymnasium floors.

Sessions 2 and 3 involved the running of timed trials while wearing the Swede-O brace, the Aircast Training brace, the Aircast Sports-Stirrup, and the Donjoy Ankle Ligament Protector. Two separate models for the Aircast brace were used to see if the width of the braces affected performance. Both braces are 9 inches in length, but the Sports-Stirrup is narrower in malleolar coverage.

Both sessions 2 and 3 consisted of: a) running one familiarization trial; b)
Fig 1.—Agility course used for timed trials. Subjects (X) start the agility course behind the baseline, next to the right (R) baseline cone. They: 1, sprint along the three-point arch until they pass the left (L) baseline cone; 2, sprint backwards along the baseline until they pass the (R) cone; 3, shuffle (without crossing feet) along the arch, while facing the basket, until they pass the “top-of-the-key” cone; 4, sprint towards the basket and around the center (C) baseline cone and continue along the baseline towards the (L) cone; 5, shuffle along the arch, while facing the basket, until they pass the top-of-the-key cone; 6, sprint towards the basket and around the (C) cone and continue along the baseline towards the (R) cone. Time is stopped when the subject crosses the finish line (F). (Subjects run around cones and run as close as possible to lines while staying outside them; • refers to cones.)

running two timed trials while wearing one of the braces; and c) running two more timed trials wearing a different brace. All ankle braces were applied to each subject’s right ankle according to manufacturers’ guidelines.11,16,18 The order in which the ankle braces were tested was randomized for each subject through the use of a table of random numbers.19

Session 4 involved: a) the running of one familiarization trial; and b) the running of two timed trials under the control condition. The running of two separate control conditions was completed to examine any learning effect that may have occurred.

Throughout testing, subjects were asked to wear the sneakers that they felt provided optimal traction (the same pair was worn during all four sessions). Before the running of any trials, during each of the four sessions, the subjects ran two warm-up laps around the gymnasium and performed quadriceps, hamstring, and hip adductor stretching exercises. A 4-minute rest period was given between all trials. The faster time of two hand-held timers was recorded to the nearest tenth of a second. Subjects were not shown any of their agility times until the final session was completed. The mean value of the two trials, for each condition, was used for data analysis.

Subjects were asked to complete a questionnaire (Fig 2) regarding how well each brace rated for support, comfort, or restriction of speed and quickness following the completion of the time trials under each bracing condition. Each subject was also asked to respond to the following brace preference question at the completion of all testing: “If you were required to wear one of the braces for activity following an ankle sprain, which one would you choose?”

To statistically analyze the agility time differences between the braces, an analysis of variance (ANOVA) with repeated measures was used. If significance was found, Tukey’s post hoc test was employed to locate the specific differences. All analyses were performed using the SAS statistical package.15 In all instances, the level of significance used was p < .05.

The Chi-square statistic was used to compare the set of observed frequencies with a set of expected frequencies for each of the questionnaire ratings of the four braces. For questions 1 and 2, subjects were
Brace Abbreviations
Swede-0 Brace (S)
AirCast Training Brace (AT)
AirCast Sports Stirrup (AS)
DonJoy Ankle Ligament Protector (ALP)

1. The ankle support provided by the ____ is:
   EXCELLENT

   The ankle support provided by the ____ is:
   EXCELLENT

   The ankle support provided by the ____ is:
   EXCELLENT

   The ankle support provided by the ____ is:
   EXCELLENT

2. The comfort provided by the ____ is:
   EXCELLENT

   The comfort provided by the ____ is:
   EXCELLENT

   The comfort provided by the ____ is:
   EXCELLENT

   The comfort provided by the ____ is:
   EXCELLENT

3. The ____ restricted my speed and quickness:
   NONE

   The ____ restricted my speed and quickness:
   NONE

   The ____ restricted my speed and quickness:
   NONE

   The ____ restricted my speed and quickness:
   NONE

Fig 2.—Subjective questionnaire for ankle braces.

asked to shade the box for each brace, which they subjectively rated from “none” (one box shaded) to “excellent” (ten boxes shaded) for support and comfort. Question 3 used the subjective rating continuum from “none” to “greatly” for rating the restriction of speed and quickness for the four braces. The level of significance used was p < .05.

Results
The Table summarizes the results of the agility times for the experimental conditions. Agility times were significantly less for Control 2 (posttest) than for control 1 (pretest) (F[1,83] = 46.5, p < .0001). This suggested that a learning effect occurred and that a further evaluation should include only braced agility times. There was a significant difference between the four braces (F[3,252] = 5.61, p < .001). Subjects performed the agility test quicker when wearing the Aircast Training Brace than when wearing the DonJoy Ankle Ligament Protector (Tukey; p < .05). No other significant differences existed between the braces (Tukey; p > .05).

Subjects felt the four braces provided unequal support ($\chi^2[12] = 854$, p < .05), comfort ($\chi^2[12] = 810$, p < .05), or restriction of speed and quickness ($\chi^2[12] = 869$, p < .05). They suggested that the Swede-O brace, the Aircast Sports Stirrup brace, and the Aircast Training brace provided excellent support and comfort and were the least restrictive of speed and quickness.

Regarding the question concerning brace preference, 42% of the subjects preferred wearing the Swede-O brace, while only 9% preferred the DonJoy Ankle Ligament Protector brace (see Table).

Discussion
Injury prevention is a common concern for all those involved with athletics. Anatomical bracing is used to reduce both the frequency and severity of injuries that occur during the performance of athletic skills. The selection of any type of bracing does not revolve entirely around supportive quality. While supportive quality remains the primary focus, other factors contribute to the effectiveness of bracing. These factors address the concerns of the athlete, which directly influence the bracing practice. The contributing factors are: 1) subjective comfort, support, and performance restriction effects, and 2) objective effects upon performance.
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Agility Time (Seconds) and Brace Preference (n = 85)

<table>
<thead>
<tr>
<th>Brace</th>
<th>Mean ± SD</th>
<th>Preference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control 1 (unbraced)</td>
<td>22.6 ± 1.7</td>
<td>20, 23%</td>
</tr>
<tr>
<td>Aircast™ Sports Stirrup</td>
<td>22.6 ± 1.9</td>
<td>22, 26%</td>
</tr>
<tr>
<td>Aircast™ Training</td>
<td>22.3* ± 1.9</td>
<td>36, 42%</td>
</tr>
<tr>
<td>Swede-O™</td>
<td>22.5 ± 2.0</td>
<td>8, 9%</td>
</tr>
<tr>
<td>DonJoy™ Ankle Ligament Protector</td>
<td>22.7* ± 1.9</td>
<td></td>
</tr>
<tr>
<td>Control 2 (unbraced)</td>
<td>22.0 ± 1.9</td>
<td></td>
</tr>
</tbody>
</table>

* Means with superscripts are significantly different.

Subjective Factors

The athlete’s perceived support, comfort, and performance directly influence an athlete’s ankle bracing preference. This was demonstrated by the results of our questionnaire and the subjects preference in braces, which is similar to the results of Alves et al. They examined the comfort, support, and brace of choice reported by 27 subjects for the Aircast Sports-Stirrup brace, the DonJoy Ankle Ligament Protector brace, the Swede-O brace, and the Kallassy brace. Each subject was asked to: 1) rank the braces from most comfortable to least comfortable; 2) rank the braces from most supportive to least supportive; and 3) choose their personal preference if they had to wear one of the four braces. Subjects ranked the braces after a 10-minute exercise session consisting of: 1) stationary bicycling for 5 minutes, 2) running basketball lines for 2 minutes, 3) running and cutting for 2 minutes, and 4) lateral slalom jumping for 1 minute.

In the Alves et al. study, the subjects rated the Kallassy, Aircast Sports Stirrup, and the Swede-O braces as the most supportive and comfortable, and rated the DonJoy Ankle Ligament Protector as providing the least support and comfort, as did the present study. The present study further found the DonJoy Ankle Ligament Protector to be the most restrictive for speed and agility and the least preferred brace of choice, as did Alves et al.

In our study, the lower rating for the DonJoy Ankle Ligament Protector brace in all three questions directly influenced its low preference percentage. The higher ratings for the three other braces suggest the subject’s preference for these braces. The higher percentage of athletes preferring the Swede-O brace over the Aircast Sports Stirrup and Aircast Training braces may be due to its design. The Swede-O brace may be viewed as easier to apply. Once the Swede-O brace is sized appropriately, according to manufacturers’ guidelines (shoe size), its lace-up design requires no adjustments or landmarking. The Aircast Sports Stirrup and Aircast Training braces require the athlete to apply the brace using the malleoli as landmarks.

Objective Factors

Our results, and those of others, suggest that some braces have little effect upon the completion of athletic skills. Paris reported no significant differences in performance of 18 elite soccer players during speed, balance, agility, and vertical jump testing. The athletes performed the skills under taped, McDavid brace, New Cross brace, Swede-O brace, and unbraced conditions. The three braces used were lace-up designs.

Burks et al. tested 30 university athletes in the broad jump, vertical jump, 10-yard shuttle run, and 40-yard sprint. They completed these skills under taped, Swede-O brace, Kallassy brace, and unbraced conditions. The speed and directional changes used during the shuttle run are recognized as a test of agility. The two braces were not significantly different compared to unbraced conditions during the shuttle run. However, there was a significant difference between tape and the Kallassy brace during the shuttle run. The three other skills reported superior performance with no ankle protection, but not all differences were statistically significant.

Green and Wright tested 12 university softball players in base running times. They reported no significant difference between the DonJoy Ankle Ligament Protector, Swede-O brace, and unbraced conditions. However, the Aircast brace (size not mentioned) significantly impaired the athletes’ running times.

Our results showed that there was a significant difference between the braced conditions and control 2 (unbraced) condition, as well as a significant difference between the two control conditions. However, there was no significant difference between any of the braced conditions and the control 1 condition. This may be attributed to a learning effect occurring during testing.

The only significant difference among the braces was between the Aircast Training brace and the DonJoy Ankle Ligament Protector brace. The slower time of the DonJoy Ankle Ligament Protector (.3-second difference) is insignificant when applied to an actual agility-type event requiring at least 22 seconds to complete.

Our results should be encouraging to athletes, coaches, and health care professionals who may have been hesitant in the past to use ankle braces. There should not be a concern for restricted performance when choosing an ankle brace for preventive support. We believe that any performance impedance that is evident in athletes who wear an ankle brace following injury may be attributed to the residual effects of the injury requiring the brace to be worn.

Conclusions

Commercial braces should continue to be chosen, based on economical benefits, ease of application, and supportive qualities. Based on our results we conclude: There is limited practical performance effect upon agility while wearing an ankle brace. An athlete’s perceived comfort, support, and performance restriction are contribut-

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ing factors that may directly influence the effectiveness of ankle bracing.

Acknowledgments
We wish to thank Aircast Incorporated, Swede-O Universal, and DonJoy for their brace donations. Also, thanks to Winslow High School, Waterville High School, and Madison Area High School athletes and administration for their participation and cooperation.

References

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The Effects of a Functional Elbow Brace on Medial Joint Stability: A Case Study

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Arie M. Rijke, MD, PhD
Kristinn Heinrichs, PhD, PT, ATC
David H. Perrin, PhD, ATC

Abstract: Medial elbow ligament sprains in athletics can be traumatic and disabling. In this case report, we outline the effect of a prototype functional elbow brace on joint stability in a female collegiate javelin thrower with an ulnar collateral ligament sprain. A valgus force to both elbows was applied using graded stress radiography (Telos GA-II/E stress device) at 0, 5, 10, and 15 kPa of pressure. The increase in gap width between the coronoid process and the medial epicondyle was measured from anteroposterior radiographs to determine medial displacement. The brace resulted in less displacement in both injured and noninjured ulnar collateral ligament; injured ulnar collateral ligament demonstrated greater displacement regardless of condition. The brace restored medial stability to the elbow joint by 49%, 38%, and 35% at 5, 10, and 15 kPa of pressure, respectively. The application of the brace may be useful in athletes with ulnar collateral ligament injuries.

Elbow injuries resulting from activities such as baseball and javelin throwing are confounding problems for athletes in these sports. Trauma to the elbow in sports involving violent collisions can also be disabling and problematic for a number of athletes. Although lateral epicondyritis is the most common injury of this joint, tension-induced problems may occur more frequently on the medial aspect of the joint. The extent of such an injury may result in compromise of the medial (ulnar) collateral ligament, leading to a significant detriment to function and performance. Numerous studies have implicated the ulnar collateral ligament, primarily the anterior oblique bundle, as being the primary stabilizer of the elbow in various degrees of flexion in response to a valgus stress.

Whether through conservative measures or surgical intervention, postinjury treatment and restoration may take a considerable amount of time. In fact, individuals having undergone operative management have required up to 1 year of functional physical therapy before full return to participation. However, in sports at the college and professional levels, athletes are often required to return to play before rehabilitation is completed. A question arises as to whether or not an orthotic device applied to the elbow will give this joint functional medial support. In this paper, we examine the effect of a newly developed functional brace on providing valgus support to the elbow of a female collegiate javelin thrower with an ulnar collateral ligament injury. At the present time, there is very little evidence available to validate the use of an orthotic device to add medial stability to the elbow joint.

Case Details: A 19-year-old white female collegiate javelin thrower (ht = 5'10", wt = 170 lb) sustained an ulnar collateral ligament injury during training 5 months prior to the testing procedure. She had injured her elbow while performing a plyometric box jump in which she accidentally landed on an outstretched arm with her elbow in full extension. She was referred by the Hand and Sports Services Section of the Orthopaedic Department to the Radiology Department for further evaluation. Stress radiographs revealed that she had sustained a partial tear of her ulnar collateral ligament. She signed an informed consent form for this study which followed the Human Rights guidelines established by the University of Virginia.

Graded stress radiography was performed with a Telos GA-II/E stress device (Austin & Associates, Fallstone, MD) and an accessory piece of equipment to hold the hand and wrist in supination (patent pending) (Fig 1). This device is equipped with a screw-threaded shaft that permits the gradual application of stress. The pressure is monitored on a light-emitting diode digital readout. Anteroposterior radiographs of the noninjured and injured elbows were taken with 0, 5, 10, and 15 kPa of pressure applied to the lateral aspect of the joint.

The brace used in this case study was a prototype for a newly developed functional elbow brace (Fig 2). The brace consists of two outer shells made of a high temperature plastic (polyethylene) which are fastened to the upper and lower arm.
with velcro straps. The medial and lateral joint hinges were heat-moulded to allow them to conform to the natural carrying angle of the elbow (15° valgus angle in full elbow extension). The brace was fitted to the subject’s elbow with two foam condyle pads placed over the medial and lateral epicondyles through which the axis of rotation of the elbow passes. By placing the axis of the plastic hinge joints over this portion of the elbow, flexion and extension of this joint was not compromised.

The testing procedure was carried out with the subject seated in an upright position and the elbow flexed 25° to unlock the olecranon from its fossa. The upper arm was held in approximately 65 to 70° of shoulder abduction and external rotation with the forearm fully supinated. The arm was placed within the Telos apparatus with a proximal stabilizing pad just distal to the axilla and a distal stabilizing pad at the hand and wrist. The pressure plate was placed over the lateral joint line and a valgus force was applied at 0, 5, 10, and 15 kPa of pressure. This graded application of pressure is the standard protocol used by the Department of Radiology with the Telos stress device.

The noninjured extremity was tested first without application of the brace, then with the brace. The same procedure was repeated with the injured extremity.

Anteroposterior radiographs were taken at each of the corresponding pressures to detect any changes in medial elbow displacement. Medial elbow displacement was measured by the distance in millimeters between the coronoid process of the ulna and the nearest point on the curved contour of the medial epicondyle. The measurement was performed using a loupe (7x) provided with a calibrated scale with 10 divisions to the millimeter (Bausch & Lomb, Inc, Rochester, NY).

To correlate pressure with the amount of medial displacement representative to the extent of ulnar collateral ligament stretching, a relative displacement ratio was calculated for the various pressures applied (d/dO). The displacement (millimeters) at zero pressure is represented by dO, and the displacement at the various pressures are represented by d. The relative displacement values in each of the four different conditions were entered into the following equation to calculate the percentage restoration to medial elbow stability in the injured arm as a result of brace application: % restoration = injured w/o brace - injured w/brace/(injured w/o brace — noninjured w/o brace).

Elbow Instability

The difference in medial joint laxity between the noninjured and injured extremities are presented in Fig 3, illustrating greater joint laxity in the injured arm than the noninjured extremity at all pressures. The table indicates higher displacement values in millimeters as well as higher relative displacement values at 5, 10, and 15 kPa of pressure in the injured extremity when compared to the noninjured extremity.

Brace Support

There was a reduction in relative displacement in the noninjured arm...
Fig 3—Relative displacement values of the medial elbow joint plotted against pressure (kiloPascals) in the noninjured and injured extremities with and without application of the brace.

Displacement (mm), Relative Displacement (d/dO) and Difference Values of the Noninjured and Injured Extremities With and Without the Application of the Brace in Response to a Valgus Stress at 0, 5, 10, and 15 kPa of Pressure.

<table>
<thead>
<tr>
<th>Pressure (kPa)</th>
<th>Noninjured</th>
<th>Injured</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonbraced</td>
<td>3.0</td>
<td>3.0</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>3.7</td>
<td>3.65</td>
<td>0.12</td>
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<td>4.1</td>
<td>4.0</td>
<td>0.33</td>
</tr>
<tr>
<td>Braced</td>
<td>3.0</td>
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</tr>
<tr>
<td></td>
<td>5.0</td>
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<tr>
<td></td>
<td>5.8</td>
<td>5.8</td>
<td>1.76</td>
</tr>
</tbody>
</table>

Discussion
The objective diagnostic technique used in this study is of prime value. Manual measurement of joint laxity as performed by the elbow valgus stress test is virtually dependent upon the skill and technique of the tester. In addition, being objectively aware of the patient’s joint laxity allows the practitioner to make more informed decisions concerning appropriate treatment.

The importance of the ulnar collateral ligament as the primary stabilizing structure to the elbow in response to a valgus stress has been investigated. The anterior bundle of the ulnar collateral ligament, referred to as the epitrochlear-coronoid fasciculi, is the strongest portion of this ligamentous complex. More recent investigators reported that the anterior band of the ulnar collateral ligament is a taut structure throughout the full range of motion and provides the primary restraint to a valgus stress. With respect to other elbow stresses, Sjøbjer and associates applied a 1.5-Nm valgus and internal rotary force to 12 cadaveric elbow specimens. They found that isolated transection of the anterior bundle of the ulnar collateral ligament resulted in significant joint instability that was not reproducible with isolated transection of the posterior oblique bundle or the joint capsule. A study of 30 cadaveric elbow specimens yielded similar results. These authors reported that isolated transection of the anterior portion of the ulnar collateral ligament resulted in significant and gross instability in response to a valgus stress at 0, 45, and 90° of elbow flexion. These studies not only indicate the importance of the ulnar collateral ligament to medial stability of the elbow, but also provide an assumption that can be made in studies such as these. It can be assumed that medial elbow instability, as measured in this study, is a result of damage to the ulnar collateral ligament.

The effect of the brace in this study appeared to reduce relative joint displacement of the elbow in response to a valgus stress (Fig 3). We could find no previous studies in the literature that examined the effect of a brace on medial elbow stability. Since the brace did have the ability to restore medial stability to the elbow by at least 35%, this poses a major question: “Would this brace offer similar support to the elbow in sport-specific patterns?” Although the results from this study cannot answer this question, they do indicate the need for further research. This is based on the fact that by reducing medial elbow displacement, the degree of stress on the ulnar collateral ligament is decreased.

Research involving a large sample size subjected to these procedures would allow for between-groups measures, and the overall consistency of results may yield more definite conclusions with respect to the effectiveness of the brace.

Another factor to be considered is the brace design. The brace used in this study was a custom-moulded prototype in which one of the authors...
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served as the model. A brace designed to accommodate varying elbow widths or a number of different brace sizes would have to be used for future study.

A longitudinal study examining the effects of the brace with use is a third factor that should be considered in future studies. Examining medial elbow laxity after an athlete returns to activity would provide information on brace effectiveness during sport-specific participation.

In this case, the brace had a more pronounced effect on the injured extremity than the noninjured extremity. The use of the brace on extremities with varying injury severities would give a better indication for use in those individuals demonstrating ulnar collateral ligament injuries to the elbow.

In conclusion, the brace tested in this case may be useful for athletes with ulnar collateral ligament injuries who are planning to return to competition prematurely. Further modifications to the prototype will be required before it can be used in an athletic setting. However, the preliminary results demonstrate a positive trend towards the restoration of medial elbow stability.

Acknowledgments
We would like to thank Carl W. Pritts and the Department of Prosthetics and Orthotics at the University of Virginia Medical Center for their assistance, and the University of Virginia Patents Foundation for their support.

References
Athletic Trainers Can Impact Health Promotion and Disease Prevention

Kathie S. Courtney, MS, ATC

Abstract: With increasing numbers of athletic trainers working in non-traditional settings and the recognition of athletic trainers as allied health professionals, it is important that athletic trainers be knowledgeable about the health risks facing the nation in the 90s. Healthy People 2000: National Health Promotion and Disease Prevention Objectives contains 300 health objectives for the nation for the year 2000. Athletic trainers have a unique opportunity to assist other health professionals in implementing these health objectives and improving the quality of life of the citizens of the United States. In this article, I present a sample of the 300 health objectives for the nation and make suggestions regarding how athletic trainers can assist in the achievement and implementation of the objectives.

The scope of practice of athletic trainers may be limited in specific ways or situations, but the scope of influence on the lives of those for whom and with whom we work is very broad. Because athletic trainers have the opportunity to influence the lives of a wide range of Americans in a variety of work settings, we are in a unique position to foster health promotion and disease prevention. As athletic trainers find employment in more nontraditional settings, it becomes even more important that we have a better than basic understanding of the health problems facing society and the methods for decreasing health risks and improving the quality of life. We can learn much from examining the health objectives for the nation.

History of Objectives Development

The development of national health objectives began with a report published by the Surgeon General in 1972. It detailed the nation’s advances in health promotion and disease prevention over a number of years. In 1980, a follow-up report expanded upon the Surgeon General’s report and established five public health goals and 226 specific objectives for the nation to be accomplished by 1990. A 1987 review of progress toward achieving the 1990 goals showed that approximately 50% of the objectives had been or were anticipated to be accomplished by 1990. At this point it was possible to see that a nation of people working together toward the achievement of a specific set of objectives, could have a dramatic impact on the health and well-being of its citizens.

Development of Current Objectives

Healthy People 2000: National Health Promotion and Disease Prevention Objectives encompasses the current set of national health objectives. The development of these objectives began in 1987 with the convening of a consortium of interested public, private, and professional agencies and organizations. The Public Health Service (PHS), using a national directory of organizations, mailed each organization listed an invitation to membership in the consortium. The consortium was charged with providing leadership in the development and implementation of the Year 2000 Objectives. Members of the National Athletic Trainers Association (NATA) will undoubtedly recognize many of the member organizations in the consortium, such as the American Physical Therapy Association (APTA), American Medical Association (AMA), American Orthopaedic Society for Sports Medicine (AOSSM), American Society for Allied Health Professions (ASAHP), National Strength and Conditioning Association (NSCA), and the American College of Sports Medicine (ACSM), who participated in the development of the health objectives.

The PHS and the Healthy People 2000 Consortium, with the assistance of the Institute of Medicine of the National Academy of Sciences (IOM) held hearings in seven cities throughout the United States. The purpose of the hearings was to gather input from the nation on the development of achievable objectives for the year 2000. A concerted effort was made to involve a broad range of individuals, schools, governmental agencies, and public, private, professional, and voluntary organizations in the hearings. Oral and written testimony was received from more than 800 individuals and organizations.

The hearings and objectives development process resulted in over 300 measurable, specific, health promotion and disease prevention objectives for the year 2000. Three broad goals embodying the purpose of Healthy People 2000 were identified (Table 1). The objectives were separated into 22 priority areas (Table 2). The priority areas are encompassed by three distinct units: health promotion, health protection, and preventive services.

The health promotion unit contains eight objective areas relating to individual lifestyle. The health protection unit is composed of five areas relating to environmental or regulatory measures that help ensure protection of large population groups.
Preventive services includes eight areas relating to counseling, screening, and immunization or chemoprophylactic interventions. The final priority area has been established for surveillance and data systems purposes. In addition, there are age-related objectives within the priority areas.

There is an association between the year 2000 health objectives and many of the content and skill areas contained in the six domains of athletic training (Prevention; Recognition and Evaluation; Management, Treatment, and Disposition; Rehabilitation; Organization and Administration; Education and Counseling). Tables 3 through 5 contain some of the Healthy People 2000 Objectives which should be of interest to athletic trainers. The 11 objectives in Table 3 are representative of the 125 objectives in the health promotion area. Tables 4 and 5 contain objectives representative of the 75 health protection objectives and 132 preventive services objectives. The objectives in the tables were selected on the basis of their relationship to athletic training and the duties, skills, and knowledge of athletic trainers. Depending upon your orientation, work setting, or specific interest areas, you may find many of the unlisted objectives of interest also.

### Action Aimed at Objectives Achievement

Since the development of the objectives, governmental agencies and private organizations have been working toward the achievement of the objectives in a variety of ways. Action plans have been developed, special programs have been instituted, and various research projects are underway. The United States Department of Health and Human Services and the PHS have published a report, Public Health Service Action, which details approximately 860 PHS activities designed to aid in the achievement of the objectives. Athletic trainers may be interested to know that one of these activities is an epidemiological study of musculoskeletal injuries associated with participation in sports and physical exercise, which is being undertaken by the National Institute of Health and the National Institute of Arthritis and Musculoskeletal and Skin Diseases.

Additionally, the PHS has also published Consortium Action, which features the actions taken by consortium members to assist in the achievement of the health objectives. The PHS published the report for several reasons. Chief among them was the desire to illustrate a public statement in support of private actions to help improve the health of all Americans and to provide testimony to the notion that health is not the sole province of the medical care community or of governments. Secondly, it presented the opportunity to begin answering the question, "What can my organization do to help the nation achieve Healthy People 2000?"

In general, some of the activities already undertaken by consortium members include: publication of the objectives to their members, highlighting objectives at annual meetings, using achievement of the objectives as the theme for annual conferences, and devoting conference sessions to how the organization and individual members can help achieve the objectives. Specific activities conducted by consortium members are reported in Consortium Action. For example, the ACSM reports that they have established a Healthy People 2000 committee and a 50-state volunteer network to coordinate Healthy People 2000 objectives. In addition, their quarterly magazine contains a column on the Healthy People 2000 program. The APTA has initiated projects to deal with Healthy People 2000 objectives related to physical activity and fitness, sports- and fitness-related injuries, anabolic steroid abuse, and exercise prescription. The APTA, besides participating in the Healthy People 2000 conference in 1990, has ordered more than 100 copies of the Executive Summary of the Report on...
### Table 3.—Health Promotion Objectives

1.6 Increase to at least 40% the proportion of people aged 6 and older who regularly perform physical activities that enhance and maintain muscular strength, muscular endurance, and flexibility.

1.10 Increase the proportion of worksites offering employer-sponsored physical activity and fitness programs as follows:

<table>
<thead>
<tr>
<th>Worksite Size</th>
<th>1985 Baseline</th>
<th>2000 Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>50–99 employees</td>
<td>14%</td>
<td>20%</td>
</tr>
<tr>
<td>100–249 employees</td>
<td>23%</td>
<td>35%</td>
</tr>
<tr>
<td>250–749 employees</td>
<td>32%</td>
<td>50%</td>
</tr>
<tr>
<td>&gt;750 employees</td>
<td>54%</td>
<td>80%</td>
</tr>
</tbody>
</table>

2.19 Increase to at least 75% the proportion of the nation’s schools that provide nutrition education from preschool through 12th grade, preferably as part of quality school health education.

2.20 Increase to at least 50% the proportion of worksites with 50 or more employees that offer nutrition education and/or weight management programs for employees.

3.9 Reduce smokeless tobacco use by males aged 12 through 24 to a prevalence of no more than 4%.

3.10 Establish tobacco-free environments and include tobacco use prevention in the curricula of all elementary, middle, and secondary schools, preferably as part of quality school health education.

4.7 Reduce the proportion of high school seniors and college students engaging in recent occasions of heavy drinking of alcoholic beverages to no more than 28% of high school seniors and 32% of college students.

4.11 Reduce to no more than 3% the proportion of male high school seniors who use anabolic steroids.

8.4 Increase to at least 75% the proportion of the Nation’s elementary and secondary schools that provide planned and sequential kindergarten through 12th grade quality school health education.

8.5 Increase to at least 50% the proportion of post secondary institutions with institution wide health promotion programs for students, faculty, and staff.

8.6 Increase to at least 85% the proportion of workplaces with 50 or more employees that offer health promotion activities for their employees, preferably as part of a comprehensive employee health promotion program.


### Table 4.—Health Protection Objectives

9.18 Provide academic instruction on injury prevention and control, preferably as part of quality school health education, in at least 50% of public school systems (grades K–12).

9.19 Extend the requirement of the use of effective head, face, eye, and mouth protection to all organizations, agencies, and institutions sponsoring sporting and recreation events that pose risks of injury.

10.2 Reduce work-related injuries resulting in medical treatment, lost time from work, or restricted work activity to no more than 6 cases per 100 full-time workers.

10.13 Increase to at least 50% the proportion of worksites with 50 or more employees that offer back injury prevention and rehabilitation programs.

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Table 5.—Preventive Services Objectives

16.9 Increase to at least 60% the proportion of people of all ages who limit sun exposure, use sunscreen and protective clothing when exposed to sunlight, and avoid artificial sources of ultraviolet light (eg, sun lamps, tanning booths).

17.2 Reduce to no more than 8% the proportion of people who experience a limitation due to chronic conditions.

18.11 Provide HIV education for students and staff in at least 90% of colleges and universities.

18.14 Extend to all facilities where workers are at risk for occupational transmission of HIV, regulations to protect workers from exposure to bloodborne infections, including HIV infection.


A comprehensive school health team, the athletic trainer will be able to use his/her knowledge and skills to promote fitness, decrease injuries, promote better nutrition in school lunches, support the fight against tobacco, drugs, and alcohol, and work to provide students with the knowledge they need to make wise health decisions.

At worksites outside of the educational setting, athletic trainers can use their expertise to promote worksite wellness programs, such as back injury prevention, physical fitness improvement, and stop smoking programs. These efforts will reduce work-related injuries and assist in boosting worker productivity.

In our communities, athletic trainers can participate in health fairs, speak to community clubs and organizations, and use their broad knowledge base and experience to promote community health programs geared toward achieving the Healthy People 2000 objectives.

Conclusion

Being recognized by the American Medical Association as allied health professionals brings added responsibility with it. As athletic trainers and allied health professionals, we have the responsibility to share in the effort to improve the health of the nation by focusing some of our attention on the health of all students in our schools, all employees at our worksites, and all members of the communities in which we reside. If we do this, and become involved in a broader aspect of health promotion and disease prevention, we truly can help the nation attain the Year 2000 objectives.

Acknowledgments

I would like to thank Dr. James Booher for his wise advice and counsel and Lisa Kane of the Office of Disease Prevention and Health Promotion for supplying some of the missing pieces in the Healthy People 2000 Consortium's history.

References

Abstract: Prevention of injury involves identifying risk factors that would predispose one to injury and developing strategies to attenuate or eliminate their presence. Because muscle glycogen depletion is associated with fatigue and injury, it should be treated as a possible risk factor. Muscle glycogen stores are derived almost entirely from carbohydrate intake. Because there is a limited capacity to store muscle glycogen, and because muscle glycogen is the predominant fuel in exercise of moderate to severe intensity, the nutritional focus should be on carbohydrate consumption. Easy-to-follow nutritional strategies should be employed that will maximize muscle glycogen stores and delay the onset of fatigue. Individuals involved in activities lasting less than 60 minutes need to consume an adequate amount of carbohydrate daily and a pre-event meal before the start of the activity. However, individuals participating in activities longer than 60 minutes or participating in activities requiring repeated bouts of high intensity exercise need to: 1) consume an adequate amount of carbohydrate daily, 2) practice carbohydrate loading, 3) consume the pre-event meal, and 4) ingest carbohydrates immediately before, during, and after the activity.

Empirically, there seems to be a relationship between fatigue and injury. Fatiguing, prolonged, continuous, and eccentric type of exercise has been associated with ultrastructural damage to the muscle fiber. Although it may be speculative, it has been suggested that fatigued muscles lose their strength and ability to protect anatomically weak joints. There is also evidence that links muscle glycogen depletion with both fatigue and injury. Because muscle glycogen depletion is associated with fatigue, and fatigue, in turn, is associated with injury, an indirect link between muscle glycogen depletion and injury is established. However, there is direct evidence relating muscle glycogen depletion with muscle fiber damage, as well as with sports-related injuries.

Prevention involves identifying and correcting for those risk factors that predispose one to injury. Since there is evidence supporting the notion that muscle glycogen depletion is not only associated with fatigue, but also with injury, it is appropriate to consider muscle glycogen depletion as a risk factor. Nutritional counseling and the implementation of easy-to-follow behavioral strategies are important tools in maximizing muscle glycogen stores, delaying the onset of fatigue, and, perhaps, preventing injury. The purpose of this paper is to: 1) examine the relationship between fatigue and injury, and between muscle glycogen depletion and injury; and 2) present carbohydrate strategies to maximize and replenish muscle glycogen stores.

The Relationship Between Fatigue and Injury

The term fatigue is very complex. Fatigue may be defined as "the failure to maintain the required energy output." Such a definition relates to voluntary exercise. It also may be defined as "the decline in force generation." This definition is more appropriate for experimental studies of electrically stimulated muscle in situ.

It is helpful to conceptualize fatigue in terms of the anatomical regions where it occurs. Fatigue develops in the central nervous system, motor nerve, neuromuscular junction, and/or the muscle. Within each anatomical region, there are many mechanisms that may contribute to the onset of fatigue, and they are likely to be interdependent, synergistic, and integrated. An understanding of muscle fatigue is important to the athletic trainer because nutritional strategies can be employed to attenuate or delay the onset. There are two basic metabolic components of fatigue that develop in the muscle region: 1) an accumulation component and 2) a depletion component. The accumulation component includes the intramuscular increase in hydrogen ions and/or diprotated phosphate, whereas the depletion component includes the decrease in calcium released from the sarcoplasmic reticulum and/or intra-muscular substrates, ie, adenosine triphosphate/phosphocreatine (ATP/PC) and glycogen.

The relationship between fatigue and injury is nebulous. It is difficult to confirm the assumption that there is a cause-and-effect relationship between fatigue and injury. However, there is evidence that suggests that fatigue is associated with injury. Empirically, fatigued individuals are vulnerable to injury. Arneheim and Prentice are of the opinion that the chronically fatigued individual may be "an injury waiting to happen." Kvitne and Jolbe support the notion that fatigue may result in the substitution of movement patterns, exposing untrained musculature and joints to injury. The investigators reported that repetitive overhand throwing fatigues the stabilizing muscles surrounding the shoulder allowing for anterior glenohumeral subluxation. The body is a complex machine, and training is a process which improves performance and reduces the risk of
injury caused by unskilled or uncoordinated muscle movement.\textsuperscript{29} Fatigue may not be the sole cause of injury, but rather a contributing factor. After reviewing the literature regarding the etiology of hamstring strains, Worrell and Perrin\textsuperscript{53} reported that fatigue was one of several factors that may contribute to this type of injury. It appears that injury is associated with fatigue.

Under the electron microscope, it is quite clear that there is muscle injury as a result of fatiguing prolonged exercise and eccentric exercise. Hagerman et al\textsuperscript{27} obtained gastrocnemius biopsy samples of 10 marathon runners immediately before and after a marathon. There was an exercise-induced deterioration and degeneration of the organelles and significant inflammation following the marathon. Sjöström et al\textsuperscript{48} also found changes in the skeletal muscle of a marathon runner. The investigators secured muscle biopsies before and after an extremely long distance run (3529 km in 7 weeks) in a 46-year-old well-trained man. The tissue preparations revealed structural abnormalities characterized by diffuse increase in connective tissue, fiber size variation, and degenerated and regenerated muscle fibers. Warhol et al\textsuperscript{50} examined the biopsies of 40 male marathon runners which were secured immediately after the completion of the race. Electron microscopy revealed myofibrillar alterations which included intra- and extracellular edema, myofibrillar lysis, disruption of the T-tubule system, and focal mitochondrial degeneration.

There is also evidence that fatiguing eccentric exercise contributes to muscle damage. Newham et al\textsuperscript{43} reported very high levels of creatine kinase in elbow flexors following maximal eccentric contractions for 20 minutes. Creatine kinase is found almost exclusively in muscle tissue and serum or plasma, and is considered an indicator of muscle damage.\textsuperscript{2,45} Friden et al\textsuperscript{41} reported Z-line disruption and streaming in human muscle fibers following an exercise protocol that involved running downstairs, which is an eccentric type of exercise.

Clinical manifestations that are associated with microscopic ultrastructural muscle damage after fatiguing eccentric exercise are soreness and tenderness. Costill et al\textsuperscript{15} reported that after 10 sets of 10 eccentric contractions of the knee extensor muscles, the subjects experienced severe muscle soreness and edema. Newham et al\textsuperscript{43} found similar results using an exercise protocol involving eccentric contraction of the quadriceps. Pain was noted approximately 8 hours after exercise and was maximal at approximately 48 hours after exercise. After a later experiment, they reported that subjects experienced muscle pain in the elbow flexors after repeated high intensity eccentric exercise.\textsuperscript{52}

The obvious clinical signs of muscle pain and tenderness as a result of ultrastructural damage to the muscle may not be quite so apparent after prolonged exercise. Hagerman et al\textsuperscript{27} reported that exercise-induced muscle soreness is apparent 12 to 24 hours in experienced and nonexperienced long distance runners. However, other studies did not support this observation.\textsuperscript{48,50} This inconsistency in the presence of muscle soreness after a long distance event could be attributed to differences in the subject's training level, perception of soreness, and/or the level of circulating endorphins.

In summary, there appears to be an association between fatigue and injury. Fatiguing prolonged exercise and eccentric exercise represent two distinct mechanisms of ultrastructural muscle damage, resulting in a common cellular pathology. The etiology of muscle damage as a result of eccentric exercise seems to be mechanical in origin. High tension developed in single muscle fibers during muscle lengthening may attribute to the ultrastructural changes.\textsuperscript{3,21,23,42,43} In comparison, prolonged exercise is associated with a depletion in muscle glycogen stores resulting in a decrease in energy production. Substrate lack may serve to be the etiology of injury to the muscle cell during prolonged exercise.\textsuperscript{15,22,46,48,50}

**The Relationship Between Muscle Glycogen Depletion and Injury**

Muscle glycogen is the storage form of glucose, which is a monosaccharide derived from carbohydrate digestion.\textsuperscript{40} Glucose provides energy in the form of ATP to fuel muscles.\textsuperscript{11,26,44} ATP is continually being broken down to adenosine diphosphate by various tissues of the body for biological work, eg, nerve transmission, circulation, tissue synthesis, glandular secretion, digestion, and muscle contraction.\textsuperscript{55} The availability of ATP is an important determinant in delaying the onset of skeletal muscle fatigue.\textsuperscript{28} Because there is only a very minute store of ATP in the muscle cell, ATP is constantly being resynthesized to provide the cell with energy.\textsuperscript{44} Foods consumed and stored are potential warehouses of ATP.\textsuperscript{35,44}

Intensity and duration of exercise, as well as the individual's fitness status and diet, are important determinants of fuel use.\textsuperscript{10-12,28,29,41} Fatigue resulting from low intensities (less than 50% VO\textsubscript{2} max), is a consequence of a central neurological component.\textsuperscript{29}

In highly trained individuals, fatigue resulting from exercise of moderate to heavy intensities (50% to 75% VO\textsubscript{2} max), coincides with liver glycogen and muscle glycogen depletion and eventually a decline in blood glucose. When liver glycogen levels become depleted, critical blood glucose is maintained for a short time by gluconeogenesis, which is the formation of glucose from a noncarbohydrate source, ie, proteins and lactate.\textsuperscript{28,44} However, this process eventually fails to keep up with the pace of skeletal muscle blood glucose use. Hypoglycemia ensues and can produce symptoms of nausea and extreme discomfort.\textsuperscript{12,39} In contrast, an unfit individual does not usually experience the depletion component of muscle fatigue at moderate to high intensities, but rather the accumulation component. Lactic acid accumulates in the body resulting in a decrease of work output. Thus, the
specific mechanism for the onset of skeletal muscle fatigue in moderate to heavy intensity exercise is dependent on one’s level of fitness.\textsuperscript{11,29,52} As exercise intensities increase to 75% to 90% VO\textsubscript{2} max, fit individuals may experience fatigue because of muscle glycogen depletion and possible lactic acid accumulation. In contrast, unfit individuals cannot tolerate this intensity for very long because of lactic acid accumulation. Thus, the mechanism of fatigue for unfit individuals is usually lactic acid accumulation and not glycogen depletion. Again, one’s level of fitness is an important issue when examining skeletal muscle fatigue at heavy intensities.\textsuperscript{11,29,52}

Very short and supramaximal bursts of activity (greater than 100% VO\textsubscript{2} max), cannot be sustained for very long. PC is stored in the muscle cell in limited amounts and is the only available substance that can be used to resynthesize ATP. Once the PC stores are depleted, extremely intense exercise can no longer be sustained.\textsuperscript{29,39}

Similar to continuous exercise, intermittent exercise results in glycogen depletion. Bergstrom and Hultman\textsuperscript{6} examined glycogen depletion in subjects after engaging in an activity performed intermittently. The investigators reported that glycogen was nearly depleted after 60 minutes of exercise. Another study reported glycogen depletion after six 1-minute sprints were performed with a 10-minute rest on a bicycle ergometer.\textsuperscript{24}

Several studies support the finding that prolonged moderate and intermittent exercise coincide with muscle glycogen depletion and relate it to injury. Using the needle biopsy technique, Eriksson et al\textsuperscript{19} examined the glycogen content of a muscle homogenate. There was a large decline in muscle glycogen content after an entire day of downhill skiing. The investigators related the finding to downhill skiing injuries and were of the opinion that depleted glycogen stores were the reason that more injuries occur toward the end of the day.

Warhol et al\textsuperscript{50} examined the association of exercise-induced muscle glycogen depletion and repletion on the myofibrillar changes in the muscle cell. Forty runners completed a marathon and needle biopsies of the lateral gastrocnemius were performed immediately, 1 week, and 1 month after the race. Muscle biopsies revealed glycogen depletion and cellular damage, ie, intra- and extra-cellular edema, myofibrillar lysis, dilation and disruption of the T-tubule system, and focal mitochondrial degeneration. Biopsies taken 1week after competition showed signs of resolution coinciding with the reconstitution of muscle glycogen. One month after competition, most of the myofibrillar damage was resolved, and muscle fibers contained an abundance of glycogen. The investigators surmised that the focal damage may result specifically from metabolic stress. In other words, there was a continued demand on the muscle to produce work in spite of depleted glycogen stores. The glycogen depletion and repletion pattern immediately after the race and during recovery correlated with restoration from myofibrillar damage.

Thus, glucose is an important substrate during prolonged moderate and intermittent exercise. There is evidence indicating that muscle glycogen stores are depleted when the exercise is continued to fatigue\textsuperscript{2,6,30} and at the end of competition in sports that are intermittent in nature, eg, soccer.\textsuperscript{4,34,36}

Both indirect and direct evidence support the notion that depleted muscle glycogen stores contribute to injury. Indirectly, it is quite clear that depleted muscle glycogen stores coincide with fatigue, and fatigue in turn is associated with injury. Although most of the evidence involves relationships rather than showing cause, many of the investigations strongly suggest a cause-and-effect relationship.

**Prevention of Injury Through Carbohydrate Strategies**

Injury prevention involves screening individuals and identifying extrinsic risk factors that may predispose one to injury. After the risk factor has been identified, appropriate modifications can be implemented to eliminate or attenuate its presence. Extrinsic injury risk factors are those that occur outside the body (eg, equipment, playing field, weather conditions, etc) and are easily corrected.\textsuperscript{46} Feeding behavior involves extrinsic choices and, therefore, can be modified through appropriate nutritional strategies.

An understanding of proper nutrition, particularly carbohydrate, is exceedingly important for the physically active individual. Depleted muscle glycogen stores are associated with fatigue and injury. Since muscle glycogen is derived mostly from carbohydrate consumption, active individuals must make a conscious effort to consume an adequate amount of carbohydrate. Nutritional strategies should focus on carbohydrate intake to maximize and replenish glycogen stores\textsuperscript{12,14} and to prevent possible injury.

**Daily Carbohydrate Intake**

Regardless of activity, adults should consume approximately 60 to 70% of their total caloric intake in carbohydrates, 22 to 30% in fat, and 12 to 20% in protein.\textsuperscript{12,16,52} To achieve the appropriate carbohydrate intake, the individual can choose one of three methods: 1) percentage of the total caloric intake, 2) g/kg of body weight, or 3) the food pyramid system (Table 1).

The percent of the total caloric intake method requires the determination of total caloric intake. Total caloric intake for the inactive is 26 to 27 kcal/kg of body weight, for the moderately active is 33 to 34 kcal/kg of body weight, for the very active is 35 to 44 kcal/kg of body weight, and for the intensely active is 55 to 66 kcal/kg of body weight.\textsuperscript{9} Multiply total caloric intake by 60% to 70% to determine the number of carbohydrate calories that should be consumed. To determine total number of carbohydrate grams, divide carbohydrate calories by 4, since 4 calories equals 1 g of carbohydrate.
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Table 1.—Three Dietary Methods for Daily Carbohydrate Intake

<table>
<thead>
<tr>
<th>Method</th>
<th>Body Weight (kcal/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Method I: Percentage of Total Caloric Intake</strong></td>
<td></td>
</tr>
<tr>
<td>1. Determine caloric intake activity level</td>
<td></td>
</tr>
<tr>
<td>a. inactive</td>
<td>5-6</td>
</tr>
<tr>
<td>b. moderately active</td>
<td>7</td>
</tr>
<tr>
<td>c. very active</td>
<td>8-9</td>
</tr>
<tr>
<td>d. intensely active</td>
<td>11-14</td>
</tr>
<tr>
<td>2. Percentages of total caloric intake</td>
<td></td>
</tr>
<tr>
<td>a. carbohydrate</td>
<td>60-70%</td>
</tr>
<tr>
<td>b. protein</td>
<td>12-20%</td>
</tr>
<tr>
<td>c. fat</td>
<td>22-30%</td>
</tr>
<tr>
<td>3. Multiply total caloric intake (from step 1) by each of the percentages in step 2 to determine the kcal of carbohydrate, protein, and fat.</td>
<td></td>
</tr>
<tr>
<td><strong>Method II: Gram/kg of Body Weight</strong></td>
<td></td>
</tr>
<tr>
<td>1. Heavy training</td>
<td>10 g/kg</td>
</tr>
<tr>
<td>2. Moderate training</td>
<td>8 g/kg</td>
</tr>
<tr>
<td>3. Light training (no less than)</td>
<td>6 g/kg</td>
</tr>
<tr>
<td><strong>Method III: Food Pyramid/Exchange System</strong></td>
<td></td>
</tr>
</tbody>
</table>

Another method of determining daily total carbohydrate intake is by gram of carbohydrate/kg of body weight. There is evidence that 8 to 10 g of carbohydrate/kg of body weight will maintain appropriate glycogen levels during heavy training. It is advisable that all active individuals should consume no less than 6 g of carbohydrate/kg/day.

The last method for determining daily carbohydrate intake uses a combination of the Food Pyramid, which was developed by the USDA in 1992, and the Exchange System, which was developed by the American Diabetic Association and the American Dietetic Association. Using the six food lists from the pyramid: 1) meats, 2) vegetables, 3) fruit, 4) bread/grain, 5) milk, and 6) fat, Coleman developed a meal plan (Table 2). The foods within each list are similar in terms of carbohydrate, fat, and protein. Table 3 reports the meal plan and exchanges for selected caloric intakes and is based on a diet containing approximately 60% carbohydrate, 15 to 20% protein, and less than 25% fat. Because the individual learns caloric, carbohydrate, protein, and fat content of a wide variety of foods, the Food Pyramid/Exchange System is an excellent educational tool.

Houtkooper developed a similar system using the Food Pyramid, but instead of using the exchanges, this author uses serving sizes and refers to the meal plan as the Sport Food Swap. The biggest drawback with Coleman’s and Houtkooper’s meal plans is that it is difficult to estimate combination foods.

Carbohydrate Loading

Carbohydrate loading is designed to increase intramuscular glycogen stores. This protocol is only beneficial for those individuals whose event is longer than 60 minutes (eg, endurance events) and whose event requires repeated bouts of high intensity exercise (eg, day-long soccer and tennis tournaments). Maximizing glycogen stores can increase time to exhaustion. Larger glycogen stores will not prevent fatigue, but will delay its onset.

The “classical” method results in a similar increase of muscle glycogen. Like the “classical” method, it begins 7 days before the event and involves a gradual tapering of activity, and a normal consumption of carbohydrate (350 g/day) on days 7,6,5, and 4 prior to the event. Three days before the event, carbohydrate intake dramatically increases to 500 to 600 g/day and is maintained until the day of the event. The “modified” method does not produce hypoglycemia and associated symptoms.

Pre-event

Pre-event meals should be eaten by active individuals 4 hours before the activity to prevent the possible onset of hypoglycemia by normalizing blood glucose and insulin levels. The pancreas releases insulin in response to carbohydrate intake. If more insulin is secreted than is needed to clear the blood of excess glucose, hypoglycemia can ensue. Although diets low in carbohydrates may produce bloating and gastrointestinal distress, it is important to stress that not all individuals experience the hypoglycemic response as a result of carbohydrate consumption.

Individuals consuming a pre-event meal 4 hours before the event should eat 4 g of carbohydrate/kg of body weight. The general rule of thumb, when consuming a pre-event meal less than 4 hours prior to the activity, is to eat fewer and fewer grams of carbohydrate as the event draws near. For example, if one consumes a meal 3 hours before the activity, then the participant should consume 3 g of carbohydrate/kg of body weight. Likewise, the participant who consumes a meal 2 hours before
Table 2.—Sample of the American Diabetic Association’s Food Exchange List (by Food Group)

1. Starch/Bread List (80 kcal)
   Carbohydrate—15 g
   Protein—3 g
   Fat—0 g

   whole wheat bread (1 slice)
   peas (1/2 cup)
   baked beans (1/4 cup)
   pasta (cooked, 1/2 cup)

2. Meat List
   Lean Meats (55 kcal)
   Carbohydrate—0 g
   Protein—7 g
   Fat—3 g

   cottage cheese (1/4 cup)
   luncheon meat (<95% fat free)
   sirloin (1 oz)
   chicken (1 oz)

   Medium Fat Meats (75 kcal)
   Carbohydrate—0 g
   Protein—7 g
   Fat—5 g

   ground beef (1 oz)
   veal cutlet (1 oz)
   mozzarella (1 oz)
   tuna (in oil, 1/4 cup)

   High Fat Meats (100 kcal)
   Carbohydrate—0 g
   Protein—7 g
   Fat—8 g

   corn beef (1 oz)
   fried fish (1 oz)
   bratwurst (1 oz)
   American cheese (1 oz)

3. Vegetable List (25 kcal)
   Carbohydrate 5 g
   Protein—2 g
   Fat—0 g

   asparagus (1/2 cup)
   carrots (1/2 cup)
   tomato (1 large)
   peppers (1/2 cup)

4. Fruit List (60 kcal)
   Carbohydrate—15 g
   Protein—0 g
   Fat—0 g

   banana (1/2)
   orange (1)
   cherries (1/2 cup)
   apple (1)

5. Milk List
   Very Lowfat Milk (90 kcal)
   Carbohydrate—12 g
   Protein—8 g
   Fat—5 g

   skim milk (1 cup)

   Lowfat Milk (120 kcal)
   Carbohydrate—12 g
   Protein—8 g
   Fat—2% milk (1 cup)

   Whole Milk (150 kcal)
   Carbohydrate—12 g
   Protein—8 g
   Fat—whole milk (1 cup)

6. Fat List (45 kcal)
   Carbohydrate—0 g
   Protein—0 g
   Fat—5 g

   avocado (1/8)
   salad dressing (oil, 1 Tbsp)
   olives (10 small)
   peanuts (20 small)

Table 3.—Meal Plans Using the Exchange Lists (Table 2) and Providing Approximately 60 to 70% Carbohydrate, 12 to 20% Protein, and 25% Fat

<table>
<thead>
<tr>
<th>Calorie Level</th>
<th>1500</th>
<th>2000</th>
<th>2500</th>
<th>3000</th>
<th>3500</th>
<th>4000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Meat</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Fruit</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>9</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Vegetable</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Grain</td>
<td>7</td>
<td>11</td>
<td>16</td>
<td>18</td>
<td>20</td>
<td>24</td>
</tr>
<tr>
<td>Fat</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>6</td>
<td>8</td>
<td>10</td>
</tr>
</tbody>
</table>

the event, should eat 2 g of carbohydrate/kg of body weight, and so forth.

Immediately Before the Exercise

It may be advantageous for individuals who participate in endurance events (longer than 60 minutes in duration), and in repeated bouts of high intensity exercise (eg, day-long soccer and tennis tournaments), to consume a liquid carbohydrate meal 1 hour before the event. A liquid carbohydrate meal promotes fluid uptake and requires a shorter gastric emptying time. It has been reported that consuming a carbohydrate drink 30 to 60 minutes before the event can increase the rate of muscle glycogen use and decrease time to exhaustion; however, several reports fail to support that finding. It is acceptable to consume carbohydrates 5 to 10 minutes before the event of moderate intensity because peak blood glucose levels occur 15 to 30 minutes after the carbohydrate ingestion. The insulin response to carbohydrate intake is blunted during exercise, and the concern for hypoglycemia is thwarted.

During Exercise

Carbohydrate intake during exercise lasting longer than 60 minutes and for events requiring repeated bouts of high intensity exercise is important because it delays the onset of fatigue. Muscle glycogen supplies the muscle with the majority of carbohydrate energy during the early portions of exercise. However, as exercise continues, muscle glycogen contributes a smaller portion while blood glucose contributes a greater percentage resulting in hypoglycemia and fatigue.

It is essential that nutritional strategies focus on maintaining adequate levels of blood glucose. Dry glucose polymers, which are mixed in water and are available commercially, work quite well to normalize blood glucose and insulin levels. To avoid a delay in gastric emptying and gastrointestinal distress, it is recommended that such drinks consist of 6% to 8% percent solution containing 15 to 20 g
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of carbohydrate/7 oz of water and be consumed every 15 minutes.\textsubscript{12,13}

**After Exercise**

To minimize postexercise fatigue, it is very important to restore muscle glycogen stores associated with repeated bouts of heavy training or physical workouts lasting 60 minutes or longer. Factors that influence muscle glycogen resynthesis are: 1) the timing of the carbohydrate ingestion after exercise, 2) the carbohydrate type, and 3) the rate of carbohydrate ingestion.

Because there is a slightly faster rate of muscle glycogen resynthesis immediately following a workout, carbohydrate should be consumed very soon after the exercise session. Fifty grams of carbohydrate for a 70-kg individual is the necessary amount to promote optimal muscle glycogen resynthesis. However, more than 50 g of carbohydrate does not enhance muscle glycogen resynthesis.\textsuperscript{7,17,18}

Glycemic index (GI) represents the effect that a particular food has upon the rate and amount of increase in blood glucose levels.\textsuperscript{51} Foods and beverages having a high-to-moderate glycemic index augment muscle glycogen resynthesis. Fifty grams of carbohydrate having a high to moderate glycemic index include: glucose (4.2 Tbsp), sucrose (4.2 Tbsp), bagels (1.6), bread (3.5 slices), baked potatoes,\textsuperscript{1} rice (1 cup), macaroni (1.5 cups), oranges,\textsuperscript{3} corn (1.2 cups), 6% sucrose solution (3.5 cups), 10% corn syrup (carbonated drink; 2.1 cups), and 20% maltodextrin solution (1.1 cups). Fructose, a carbohydrate found in fruits and honey, has a low glycemic index and produces a slow rate of muscle glycogen resynthesis.\textsuperscript{7,17,18,37}

It is recommended that following a workout, 600 g of carbohydrate should be consumed by a 70-kg person within a 24-waking-hour period to completely replenish muscle glycogen stores. The maximal rate of muscle glycogen resynthesis immediately following exercise is 7% to 8% per hour. Approximately 2 to 4 hours after exercise the maximal rate of muscle glycogen resynthesis slightly decreases to 5% to 6% per hour. Approximately 50 g of carbohydrate should be ingested every 2 hours for a period of 24 waking hours to maximize muscle glycogen resynthesis.\textsuperscript{17,18,33}

Thus, to hasten the postexercise recovery between workout sessions, the active individual should consume approximately 50 g of a high-to-moderate glycemic carbohydrate immediately following the exercise bout. Thereafter, 50 g of a high to moderate glycemic carbohydrate should be consumed every 2 hours/24 waking hours. Practicality, palatability, and preference of foods should dictate what is consumed. In terms of muscle glycogen resynthesis, beverages have no advantage over foods. The amount and timing, as well as the glycemic index, are very important factors in postexercise muscle glycogen resynthesis.

Injury prevention is one of the six domains reported in the 1990 role delineation study conducted by the NATA\textsuperscript{8} and involves identifying risk factors that make one vulnerable. Muscle glycogen depletion is not only associated with fatigue, but also with injury. Athletic trainers should employ easy-to-follow nutritional strategies that would maximize muscle glycogen stores and delay the onset of fatigue.

If an active individual has normal glycogen stores and participates in an activity lasting less than 60 minutes or in an event requiring repeated bouts of high intensity exercise, then it is unlikely that glycogen stores will be depleted. However, if that same individual participates in an event lasting longer than 60 minutes, then glycogen stores may be depleted and nutritional strategies should focus on daily carbohydrate intake, carbohydrate loading, the pre-event meal, and carbohydrate intake immediately before, during, and after the event.

**References**

29. Hasson SM, Barnes WS. Effect of carbohydrate-


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Modified Lachman Test for Anterior Cruciate Ligament Stability

William R. Whitehill, EdD, ATC
Kenneth E. Wright, DA, ATC
Karin Nelson, ATC

The Lachman test is just one of several stress tests that health care providers commonly use to help determine the integrity of the anterior cruciate ligament. This test is performed with the athlete in a supine position, relaxed, and with both knees exposed to allow for a comparative evaluation. The mechanics of the Lachman test necessitate that the examiner have hands large enough to hold the distal aspect of the thigh and the proximal aspect of the lower leg with enough strength to support those structures while stressing the knee in the anterior/posterior plane.

While the Anterior Drawer and Lachman stress tests provide the athletic trainer with data to evaluate the injured knee, the mechanics of the Lachman make it difficult for some to perform. This modified stress test for the ACL differs from the alternative Lachman presented in the Draper article in that this test does not require two examiners to perform the test. Therefore, the option presented allows the athletic trainer to perform the test without assistance. Furthermore, this option allows for a full evaluation in both the athletic training facility and at sports competition. This modification of the Lachman will allow athletic trainers to perform this ACL stress test with less dependency on the size and/or strength of the evaluator’s hands. We will present two positions: 1) the test being performed on an examination table; and 2) the test performed in an athletic setting.

The modified Lachman test in the athletic training facility is performed with the athlete supine on an examination table, the knee at the edge of

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Karin Nelson is a graduate assistant at Middle Tennessee State University.
Fig 3.—Position of athlete for modified Lachman without an examination table.

The table, lower leg hanging off the table (at approximately 30° flexion), and the foot on the thigh of the examiner (Fig 1). When the left knee is being stressed, the examiner’s right hand is placed on the distal aspect of the thigh in order to stabilize it. The left hand is cupped around the proximal portion of the lower leg and pulls in the anterior plane (Fig 2).

Fig 4.—Hand placement for modified Lachman without an examination table.

The examiner’s thigh provides the base of support for the lower leg and relieves the tension for the anterior cruciate ligament. The anterior pull will provide approximately 6 to 10 mm of displacement if the ACL is injured. Therefore, the size and/or strength of the examiner’s hands are less of a factor in the examination of the ACL when using the modified Lachman stress test. Conversely, when the right knee is tested, the examiner’s left hand is on the athlete’s thigh and the examiner’s right hand will perform the anterior pull.

When the ACL needs to be evaluated in a competitive setting and no examination table is available, the modified test can be performed with minimal equipment. The knee that is being tested is supported by a rolled-up towel or similar support (Fig 3). The hand placements are the same as with the first modification. The athlete’s foot is no longer supported by the examiner’s thigh, but instead the athlete’s heel is stabilized by the playing surface (Fig 4). The stress test is performed the same, with the examiner’s hand on the lower leg providing the anterior pull necessary to displace the lower leg if the ACL is affected. This modification produces the same results as the original Lachman test.

References
Using Electrocautery in Subungual Hematomas

Scott A. Street, MS, ATC
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D. Montgomery Hunter, MD
Walton W. Curl, MD

A subungual hematoma is the collection of blood under the fingernail or toenail. It can be caused by blunt trauma (such as being struck with an object such as a baseball) or can result from a crushing injury (such as being stepped on, pinched, or dropping an object on the nail). It is also often seen as the result of wearing shoes that have too small of a toe box.

Two most common methods of releasing the pressure of the subungual hematoma are: the scalpel or small gauge drill method and the hot paper clip method.

Technique 1. Scalpel or Small Gauge Drill Method
1. The injured nail should be coated with an antiseptic solution.
2. The scalpel or small gauge drill is used to penetrate the injured nail by rotary action. If the hematoma extends to the end of the nail, it may be best to release the blood by slipping the scalpel under the front edge of the nail.

Technique 2. Hot Paper Clip Method
1. A paper clip is heated to a red-hot temperature.
2. The red-hot paper clip is pressed into the surface of the nail with moderate pressure. This creates a hole in the nail at the site of the hematoma.

Technique 3. Cauterization Method
A third method is surgical cauterization. A portable, battery-powered unit, similar to a penlight and adapted to relieve the pressure associated with subungual hematomas, can be used (Figure). This unit is disposable and costs approximately $6.00. The cauterization unit method is quick, efficient, and pain-free.

Since blood and body fluids are present, universal precautions should be followed, including the disposal of biohazardous waste.
1. Heat tip of the cauterization unit by pressing the on/off button.
2. Place tip of cauterization unit on the nail. Apply light continuous pressure. A hole will be "melted" through the nail and allow the pooled blood to escape.
3. Discard unit after use.

Although there is some expense with the surgical cauterization method, the expense should not preclude its use. The infrequent nature of the injury and the fact that the athlete does not exhibit the anxiety associated with the other methods can justify the expense. This method is also easier for the health care provider as opposed to the hot paper clip method, as one does not have to continue to reheat the paper clip and push it through the nail.

Acknowledgments
We would like to thank Lynn Heflin, Elizabeth Coyle, and Dottie Nixa for their contribution to this project.

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Individuals with anterior cruciate ligament deficiency typically do not have quadriceps activity during stance. This aberrant pattern has been termed ‘quadriceps avoidance gait.’ We performed gait analysis during walking on 10 normal controls and 10 subjects 8 to 12 months after they had anterior cruciate ligament reconstruction using autogenous middle third of the patellar tendon. All patients had good subjective and objective results at the time of analysis. Differences in gait between subjects and controls persisted up to 12 months after surgery. Specifically, subjects with anterior cruciate ligament reconstructions demonstrated significant reductions in midstance knee flexion moments (p < .01) and tibially directed loading rates (p < .05) when compared with controls. However, the subjects had a net external flexion moment throughout most of the stance phase of gait, implying that quadriceps activity was present. After anterior cruciate ligament reconstruction, there is a tendency toward gait normalization, and a quadriceps avoidance mechanism is no longer present.

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The results of 101 consecutive arthroscopic meniscal repairs were studied to determine the nature and frequency of associated complications. All arthroscopic repairs were done by the senior author (OS) between November 1984 and June 1991. Our data include 65 patients with associated anterior cruciate ligament injuries, 49 of whom underwent concurrent arthroscopic anterior cruciate ligament reconstruction. There was an overall complication rate of 18%. There was a 20% risk of complication with meniscal repair when associated with anterior cruciate ligament injury and 14% without anterior cruciate ligament injury. There was a 10% incidence of arthrofibrosis when meniscal repair was performed with anterior cruciate ligament reconstruction and a 6% incidence when performed in an anterior cruciate ligament-deficient, non-reconstructed knee. Overall, there was a 13% risk of complication with lateral repairs compared with 19% with medial repairs. In the subset of patients with intact anterior cruciate ligaments and isolated meniscal lesions, there were no complications associated with lateral repair and an 18% risk of complication with medial repair. Female patients demonstrated a higher likelihood of complication (29%) than male patients (13%). Excluding repair failures, there was an 8% reoperation or rehospitalization rate.

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The associations between participation in several specific sports, use of free weights, and use of weight-lifting equipment and herniated lumbar or cervical intervertebral discs were examined in a case-control epidemiologic study. Specific sports considered were baseball or softball, golf, bowling, swimming, diving, jogging, aerobics, and racquet sports. Included in the final analysis were 287 patients with lumbar disc herniation and 63 patients with cervical disc herniation, each matched by sex, source of care, and decade of age to one control who was free of disc herniation and other conditions of the back or neck. Results indicated that most sports are not associated with an increased risk of herniation, and may be protective. Relative risk estimates for the association between individual sports and lumbar or cervical herniation were generally less than or close to 1.0. There was, however, a weak positive association between bowling and herniation at both the lumbar and cervical regions of the spine. Use of weight-lifting equipment was not associated with herniated lumbar or cervical disc, but a possible association was indicated between use of free weights and risk of cervical herniation (relative risk, 1.87; 95% confidence interval, 0.74 to 4.74).

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The effect of an isolated injury of the posterior cruciate ligament on the articular cartilage and menisci has not been extensively studied. Intraarticular abnormalities in 88 arthroscopically proven posterior cruciate ligament tears in symptomatic patients with straight unidirectional posterior instability were reviewed. There were 33 patients with acute injuries (range, 3 to 21 days; mean, 14)
and 55 patients with chronic tears (range, 28 to 3650 days; mean, 786). Of the acute injuries, chondral defects occurred in 4 patients (12%) and meniscal tears in 9 patients (27%; 6 lateral and 3 medial). Chondral defects of both the lateral femoral condyles and patella were present in all 4 patients. Of the chronic injuries, chondral defects occurred in 27 (49%) and meniscal tears in 20 patients (36%) (7 lateral and 17 medial). Chondral defects of the medial femoral condyle were most common. The mechanism of injury resulting in an isolated injury of the posterior cruciate ligament is most likely to affect the lateral compartment or the articular cartilage of the patella. The incidence of articular defects and the incidence of meniscal tears increased in patients with chronic posterior cruciate ligament injuries; both lesions increased most in the medial compartment.

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To evaluate the effectiveness of subcutaneous subfascial anterior transfer of the ulnar nerve in the surgical treatment of cubital tunnel syndrome in athletes, we retrospectively reviewed athletes undergoing subcutaneous anterior transfer of the ulnar nerve at the elbow. Criteria for inclusion in the study included active participation in athletic activity, confirmed cubital tunnel syndrome, failure to respond to conservative treatment, and having an anterior subcutaneous subfascial transfer as the only procedure performed. Twenty athletes underwent a total of 21 procedures. Results were evaluated by time to return to sport and a questionnaire developed to evaluate elbow function in the athlete. The athletes returned to full activity at an average of 12.6 weeks. Average subjective postoperative scores were 84. Elbow rating scores averaged 9 (range, 0 to 10). Anterior subcutaneous subfascial transfer of the ulnar nerve is a safe, effective means for treating cubital tunnel syndrome in athletes. The findings in this study are significant in that they confirm the effectiveness of the subcutaneous subfascial transfer procedure in returning the athlete to competition. Of secondary importance is the development of an elbow rating questionnaire appropriate to the athlete.

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Thirty-five patients had reconstruction of the anterior cruciate ligament with intraarticular fresh-frozen Achilles tendon allograft and extraarticular tibial band tenodesis. Patients were followed 2 to 4 years (mean, 2.5). Evaluation included clinical and functional examinations, measurement of tibiofemoral displacement, and anteroposterior and lateral radiographs. Clinical results were considered satisfactory in 85% of the patients; 16 had arthroscopic examination after the allograft; allograft biopsies in 9 at this time showed cellular and vascular tissue without evidence of immune reaction. Clinical, arthroscopic, and biopsy results were favorable, but radiologic results were not. In most patients, there was a significant size increase in femoral and tibial bone tunnels, as measured from radiographs. In the 6 most extreme cases, bone tunnels measured 20 mm or more in diameter, twice the initial size. Etiology and clinical significance of these bone tunnel changes remain unknown. Enlargement appears to occur early after operation; it stabilizes within 2 years. No stas-
tical correlation was seen between tunnel enlargement and results of clinical and functional examinations; nevertheless, unexplained tunnel enlargement is cause for concern, and allograft replacement of the anterior cruciate ligament with fresh-frozen Achilles tendon allograft should be considered a salvage procedure.

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Thirty-seven bone-patellar tendon-bone composite grafts from the knees of 21 human cadavers were tested to failure. Average donor age was 28 years. The composites were divided into 4 groups: 3 groups with 10 grafts (5 pairs) and 1 group with 7 grafts from 6 donors. In Group 1, we tested 10- versus 15-mm wide grafts that were used without twisting; Group II, 10-mm wide grafts without twisting versus 10-mm wide grafts that were twisted 90°; Group III, 10-mm wide grafts twisted 90° versus 10-mm wide grafts twisted 180°; and Group IV, 10- versus 7-mm wide grafts that were not twisted. The tests were performed using a newly described potting technique and clamp system and a servohydraulic testing machine with an elongation rate of 5 cm/sec. The results of this study suggest that the central third of the patellar tendon is stronger than previously reported. The mean ultimate load of a 15-mm bone-patellar tendon-bone composite was 4389 N (±708); of the 10-mm wide composites, 2977 N (±516); and of the 7-mm composites, 2238 N (±316). Twisting the graft 90° increased the strength (p < .05). Further twisting to 180° had no significant effect compared with twisting 90°. This study supports the practice of using smaller (10 mm) bone-patellar tendon-bone grafts to avoid the potential complications of patellar fracture and graft impingement in the notch.

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Forty-six limbs in 28 patients were surgically treated for exertional compartment syndrome. One group of 16 patients (26 limbs) underwent a fasciotomy for exertional anterior compartment syndrome (Group 1). A second group of 12 patients (20 limbs) underwent a fasciotomy for exertional deep posterior compartment syndrome (Group 2). Patients in Group 2 experienced symptoms for a significantly longer time than those in Group 1:16 versus 6.8 months (p < .01). All three of the pressure measurements used in this study (resting pressure, 1 minute after exercise, and 5 minutes after exercise) were significantly higher in both groups than in normal controls (p < .01). The 1 minute after exercise values were significantly higher in Group 1 (mean, 36.5) than in Group 2 (mean, 29.1) (p < .01). In Group 1, 25 of 26 limbs (96%) had excellent results. In Group 2, 13 of 20 limbs (65%) had satisfactory results (5 excellent and 8 good) and 7 (35%) had unsatisfactory results (4 fair and 3 poor). Those patients who had an unsatisfactory outcome did so within 6 months. Patients in Group 1 had a significantly higher rate of satisfactory results than those in Group 2 (p < .05).

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One hundred eleven patients with acute rupture of the Achilles tendon were included in a prospective trial and randomly assigned to groups for operative (56 patients) or nonoperative (55 patients) treatment. All of the patients were followed with clinical evaluations at 4 months and 1 year after the rupture. The major complications in the operative treatment group were three reruptures and two...
deep infections as compared with seven reruptures, one second rerupture, and one extreme residual lengthening of the tendon in the nonoperative group. There were fewer minor complications in the nonoperative group than in the operative group. The operatively treated patients had a significantly higher rate of resuming sports activities at the same level, a lesser degree of calf atrophy, better ankle movement, and fewer complaints 1 year after the accident. The conclusion we reached through this randomized prospective study is that operative treatment of ruptured Achilles tendons is preferable, but nonoperative treatment is an acceptable alternative.

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The diagnostic accuracy of the clinical examination for intraarticular injuries of the knee was documented by arthroscopy over a 6-month period. Two-hundred ninety patients (296 knees) were evaluated by history, physical examination, and standard radiographs. Supplemental diagnostic studies included 41 magnetic resonance images, 2 arthrograms, and 1 previous arthroscopy that had been recently performed. Overall, the correct diagnosis was made in 165 knees (56%), an incomplete diagnosis in 92 (31%), and an incorrect diagnosis in 39 (13%). There were only 2 knees (0.07%) with no discernable lesions. When a single lesion was present in the knee, the diagnosis was made correctly in 72% of cases. When more than 2 were discovered, the diagnosis was correct in only 30%. However, all individual lesions were diagnosed with an accuracy of greater than 90%. The lesions most difficult to diagnose were chondral fractures, fibrotic fat pads, tears in the anterior cruciate ligament, and loose bodies. Knees with acute lesions and those with a single diagnosis proved to be significantly easier to diagnose (p < .01). The variables that proved to be insignificant were age, sex, magnetic resonance imaging, surgeon, workers’ compensation, or pending litigation.

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Because we noticed patients had difficulty regaining full range of motion after surgery for a locked bucket-handle meniscal tear with simultaneous reconstruction for a chronic anterior cruciate ligament tear, we adopted a two-stage procedure for this group of patients. We evaluated the results of a two-stage procedure in the knees of 16 athletes (Group 1) and compared their outcome with the outcome of 16 matched athletes who had been treated with simultaneous repair or removal of the displaced bucket-handle meniscal tear and autogenous patellar tendon anterior cruciate ligament reconstruction (Group 2). Four patients in Group 2 required a second procedure or casting to regain full extension. No patient in Group 1 required a second procedure. One meniscal re-tear was detected in Group 1. The two-stage procedure also appears to have a number of theoretical advantages: 1) more aggressive use of repair rather than removal of a displaced torn meniscus, 2) prevention of problems in regaining range of motion, 3) allows a second look to judge the success of meniscal repair, and 4) allows time for the patient to prepare for anterior cruciate ligament reconstruction physically, mentally, academically, and socially.

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The purpose of this study was to quantify the amount of anterior tibial displacement occurring in anterior cruciate ligament-deficient knees during two types of rehabilitation exercises: 1) resisted knee extension, an open kinetic chain exercise; and 2) the parallel squat, a closed kinetic chain exercise. An electrogoniometer system was applied to the anterior cruciate ligament-deficient knee of 11 volunteers and to the uninjured normal knee in 9 of these volunteers. Anterior tibial displacement and the knee flexion angle were measured during each exercise using matched quadriceps loads and during the Lachman test. The anterior cruciate ligament-deficient knee had significantly greater anterior tibial displacement during extension from 64° to 10° in the knee extension exercise as compared to the parallel squat exercise. In addition, the amount of displacement during the Lachman test was significantly less than in the knee extension exercise, but significantly more than in the parallel squat exercise. No significant differences were found between measurements in the normal knee. We concluded that the stress to the anterior cruciate ligament, as indicated by anterior tibial displacement, is minimized by using the parallel squat, a closed kinetic chain exercise, when compared to the relative anterior tibial displacement during knee extension exercise.

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BACKGROUND AND PURPOSE—The purpose of this study was twofold: 1) to determine whether passive wrist flexion and extension goniometric measurements using ulnar alignment, radial alignment, and volar/dorsal alignment were similar or dissimilar, and 2) to examine which of these three techniques had the greatest intratester and intertherapist reliability. SUBJECTS—One hundred forty patients (141 wrists) were measured. The testers were 32 therapists from eight different hand/upper-extremity clinical sites around the United States. METHODS—Randomly paired testers measured passive wrist flexion and extension. The intraclass correlation coefficient (ICC) was used as an estimate of agreement for both intratherapist (model 3.1) and intertherapist (model 2.1) reliability. RESULTS—Six of the eight clinics showed significant differences among the various goniometric techniques. Flexion intratherapist mean ICCs for the radial, ulnar, and dorsal alignment techniques were .86, .87, and .92, respectively. Extension intratherapist mean ICCs were .80, .80, and .84 for the three techniques. Intertherapist flexion mean ICCs were .88, .89, and .93 for the radial, ulnar, and volar alignment techniques, respectively. Extension intertherapist mean ICCs were .80, .80, and .84 for the three techniques. The standard error of measurement was also used to quantify reliability, with the volar/dorsal alignment technique consistently producing less error than the ulnar and radial alignment techniques. The generalizability theory statistical model was used to identify the sources of error. The patient contributed to variance the most, although inherent error within the study, diagnostic category, therapeutic approach, and goniometric technique also contributed. CONCLUSION AND DISCUSSION—The overall results indicated there were differences among the three goniometric techniques. The volar/dorsal alignment technique is the goniometric technique of choice, as it consistently had the greatest reliability.

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**BACKGROUND AND PURPOSE**—The purpose of this study was to determine the effects of different orthotic posting methods on controlling abnormal foot pronation during ambulation. **SUBJECTS**—Twenty-two individuals with forefoot varus deformities of at least 8° (13 women, aged 21-40 years, and 9 men, aged 20-50 years) participated in the study. The female subjects had an average height and weight of 162.6 cm (64 in) and 55.3 kg (122 lb), and the male subjects had an average height and weight of 175.3 cm (69 in) and 80.7 kg (178 lb). **METHODS**—The subjects were examined with a computerized video motion analysis system. A control trial consisted of walking at 4.0 km/h in running shoes. Experimental trials included walking at 4.0 km/h in running shoes with unPosted orthotic shells and with orthotic shells posted in the forefoot, the rear foot, and both forefoot and rear foot. **RESULTS**—Maximal calf-to-calcaneus and calcaneus-to-vertical angles were decreased more by orthoses posted in both the forefoot and the rear foot than by orthoses posted only in the forefoot. No difference in maximal calf-to-calcaneus and calcaneus-to-vertical angles were found with combined forefoot and rear-foot posting compared with posting in the rear foot alone. The maximal calf-to-calcaneus angle was decreased by orthoses posted in any of the three methods and by the orthotic shell alone when compared with shoes alone. The maximal calcaneus-to-vertical angle was decreased by orthoses posted in any of the three methods, but not by the orthotic shell alone when compared with shoes alone. **CONCLUSION AND DISCUSSION**—Clinicians should consider combined posting or rear-foot posting alone when maximal control of rear-foot frontal-plane pronation is desired, though forefoot posting alone and the orthotic shell also provide control of rear-foot frontal-plane pronation.


Functional electrical stimulation (FES) of paralyzed muscles holds promise as a strategy to assist patients in executing functional movements after spinal cord injuries. Muscle atrophy is one of the major problems that must be addressed for this approach to be successful. Loss of muscle mass may occur as a result of lesions to motoneurons in either the spinal cord or the central command pathway, or a combination of the two. For injuries to spinal motoneurons, muscle fibers undergo denervation atrophy. Damage to the central command pathway, on the other hand, results in disuse atrophy. In association with atrophy, the low contractile forces and inability of the muscles to sustain contractions are of direct therapeutic concern. In this review, methods aimed at recovery of function of paralyzed limbs by reducing susceptibility to fatigue and atrophy of paralyzed muscles are discussed. One is related to promoting nerve sprouting in partially denervated muscles to reinnervate muscle fibers and reverse denervation atrophy. The other regards training of paralyzed muscles to increase strength (muscle force) and endurance (fatigue resistance) by means of FES. Most training regimens with low-frequency FES increase muscle endurance. Efforts to design optimal regimens for increasing both muscle strength and endurance must involve consideration of several factors that are still controversial. These factors, which include muscle properties (such as fiber type composition and physiological type) and conditions imposed on the muscle (such as loading), are discussed in detail.


**BACKGROUND AND PURPOSE**—Changes in sensory information have been shown to influence muscle function locally. Some clinicians, however, believe that the influence may be more extensive. To investigate this clinical concept, subjects with severe ankle sprain were assessed for local sensation changes and proximal hip/back muscle function. **SUBJECTS**—Of a total of 361 potential subjects whose medical histories were assessed, 20 men (age 18 to 35 years) who had previously sustained a severe unilateral ankle sprain and 11 matched control subjects with no previous lower-limb injury participated in the study. **METHODS**—Using this experimental model, tests of vibration sensation in the ankle (indicating sensation changes) as well as surface electromyography of muscle recruitment patterns for hip extension (indicating muscle function proximally) of the biceps femoris, glutaeus maximus, and lumbar erector spinae muscles were made on both sides of the unilateral injured and matched control subjects. **RESULTS**—Significant decreases in vibration perception and significant delays in glutus maximus muscle recruitment during hip extension were found in the injured group. **CONCLUSION AND DISCUSSION**—The author concludes that local sensory and proximal muscle function changes are associated with unilateral severe ankle sprain.

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Contraction-induced injury results in the degeneration and regeneration of muscle fibers. Of the three types of contractions—shortening (concentric), isometric, and lengthening (eccentric)—injury is most likely to occur and the severity of the injury is greatest during lengthening contractions. The magnitude of the injury to muscle fibers may be assessed by direct measures of cellular and ultrastructural damage; by indirect measures of changes in enzyme efflux, calcium influx, ratio of oxidized to reduced glutathione, and force development; and, in human beings, by reports of muscle soreness. The sequence of events includes an initial injury that is primarily mechanical and a secondary metabolic, or biochemical, injury that peaks 1 to 3 days after the injurious contractions. The recovery from contraction-induced injury is usually complete within 30 days. Repeated exposures to protocols of lengthening contractions result in trained muscles that are not injured by the protocol that previously caused injury.

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Muscle fatigue can be defined as a decrease in the force-generating ability of a muscle that resulted from recent activity. Recent studies of muscle fatigue are reviewed that are relevant to two areas of interest to physical therapists: clinical assessment of muscle fatigue and neuromuscular electrical stimulation. Volitional and electrical tests have been

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used to quantify muscle fatigue. Several variations on each type of test are discussed, as are the possible sites in which fatigue might occur. The rate of fatigue during the therapeutic application of electrical stimulation of skeletal muscle is much greater than that seen during volitional contractions. Factors contributing to this phenomenon are examined. The unique requirements affecting how stimulus variables can be manipulated to minimize muscle fatigue in three specific therapeutic uses of neuromuscular electrical stimulation are addressed.

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This review article is designed to expose physical therapists to an examination of muscle organization and the implications that this organization has for therapeutic applications. The partitioning hypothesis is based on the fact that an individual muscle is arranged in a more complex array than simply fibers attaching at aponeuroses, tendons, or bones with a single muscle nerve innervation. Neuromuscular compartments, which are distinct subvolumes of a muscle, each innervated by an individual muscle nerve branch and each containing motor unit territories with a unique array of physiological attributes, are described. In addition, the organization of individual muscles into these subunits is paralleled by the organization of their parent motoneurons within the spinal cord. These notions are detailed in a review of data derived from studies performed primarily in cat and rat models. Recent data derived from morphological and anatomical study of human muscles support the existence of similar neuromuscular partitions. These data are complemented by physiological studies, the results from which suggest that partitions may have functional or task-oriented roles; that is, different portions of one muscle may be called into play depending on the task demands of the situation. The importance of these observations for reconsidering how we provide clinical applications, such as neuromuscular stimulation or kinesiological monitoring, is discussed.

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Skeletal muscles are the primary organ system responsible for force generation and movement. As such, an improved understanding of normal movement can be obtained by understanding skeletal muscle mechanical properties. In this review, we present the basic mechanical properties of skeletal muscle in a way that relates to their normal function. First, isometric force production is discussed, followed by a presentation of isotonic force production. Then, skeletal muscle architectural properties are presented as a strategy for muscles to specialize in either force production or excursion. Finally, we discuss the relationship between muscles and joints and the significance of this relationship for understanding strength. Based on this presentation, the therapist will have an improved understanding of normal movement and may have insights into developing rehabilitation protocols that can improve function.

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The capabilities of the different types of motor units are reviewed, and their properties in a variety of muscles are discussed. Because the tension-generating capacities of motor units are so different, the order in which they are recruited will have a strong influence on the way force output of the whole muscle is graded. Activation of motor units in a random order produces a roughly linear force increase with progressive recruitment, whereas recruitment of motor units in order of increasing force produces an approximately exponential force increase as the number of active motor units increases. The latter scheme allows fine control of weak movements and rapid production of powerful movements. Motor units are shown to be well adapted to the tasks they must perform, and a compromise motor unit will not fulfill all the tasks demanded of it. Finally, changes in motor unit properties produced by different activity patterns and by muscle reinnervation are reviewed, and the implications for rehabilitation are discussed.

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**BACKGROUND AND PURPOSE**—This correlational study describes factors that are related to patient compliance with exercise regimens during physical therapy. We investigated whether patient compliance was related to characteristics of the patient or the patient’s illness, to the patient’s attitude, or to the physical therapist’s behavior.

**SUBJECTS AND METHODS**—Of a random sample of 300 physical therapists in private practice in the Neth-
erlands, 222 therapists responded to a questionnaire survey. Eighty-four respondents also made audio recordings. Materials of the study were 1,931 registration forms, 1,837 audio-recorded sessions of physical therapy sessions, and 1,681 patient questionnaires. RESULTS—The results show that the three main factors related to noncompliance were: 1) the barriers patients perceive and encounter, 2) the lack of positive feedback, and 3) the degree of helplessness. The first factor, the barriers patients perceive and encounter, shows the strongest relation with noncompliance. The results also show that noncompliance is more strongly related to the characteristics of the illness than to the illness, a bad prognosis is negatively related to compliance, and much hindrance of the complaint is positively related to compliance. There was no difference between men and women with regard to patient compliance, but less educated patients were slightly more compliant than more highly educated patients.

CONCLUSION AND DISCUSSION—These correlative findings can be used to formulate hypotheses of cause and effect in future clinical research. Future research should take into account the type and efficacy of therapeutic exercises for different diseases. For physical therapy practice, it seems important that physical therapists carefully explore which problems patients encounter in their efforts to comply and that they seek solutions to those problems in mutual cooperation with their patients.

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BACKGROUND AND PURPOSE—The objectives of this study were: 1) to describe the extent to which practicing physical therapists and physical therapy students have reported experiencing inappropriate patient sexual behavior (IPSB), 2) to document the consequences of IPSB, and 3) to identify the strategies the subjects have used to manage IPSB.

SUBJECTS AND METHODS—A survey questionnaire was sent to 118 physical therapists and 87 physical therapy students. Completed questionnaires were returned by 74.1% of the subjects (over 70% in each group). RESULTS—The majority of respondents (80.9%) reported having encountered some level of IPSB. Although almost half of the physical therapists and one third of the third- and fourth-year students reported experiencing severe IPSB, including forceful sexual touching and deliberate sexual exposure, only 20% of the respondents perceived that they had been sexually harassed. Most of the respondents were satisfied with the way in which they handled the IPSB; however, almost 90% considered that in-service and undergraduate education would be desirable. CONCLUSION AND DISCUSSION—I is concluded that this problem should be addressed by further study with a broader sample and by inclusion of these issues in education programs for students and physical therapists.

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BACKGROUND AND PURPOSE—The purpose of this study was to evaluate and compare the muscle activity of the supraspinatus, infraspinatus, teres minor, and lower trapezius muscles during commonly prescribed therapeutic exercises in subjects with and without shoulder muscle activity of the supraspinatus, infraspinatus, teres minor, and lower trapezius muscles during commonly prescribed therapeutic exercises in subjects with and without shoulder muscle activity of the supraspinatus, infraspinatus, teres minor, and lower trapezius muscles during commonly prescribed therapeutic exercises in subjects with and without shoulder muscle activity of the supraspinatus, infraspinatus, teres minor, and lower trapezius muscles during commonly prescribed therapeutic exercises in subjects with and without shoulder muscle activity of the supraspinatus, infraspinatus, teres minor, and lower trapezius muscles during commonly prescribed therapeutic exercises in subjects with and without shoulder muscle activity of the supraspinatus, infraspinatus, teres minor, and lower trapezius muscles during commonly prescribed therapeutic exercises in subjects with and without shoulder muscle activity of the supraspinatus, infraspinatus, teres minor, and lower trapezius muscles during commonly prescribed therapeutic exercises in subjects with and without shoulder muscle activity of the supraspinatus, infraspinatus, teres minor, and lower trapezius muscles during commonly prescribed therapeutic exercises in subjects with and without shoulder muscle activity of the supraspinatus, infraspinatus, teres minor, and lower trapezius muscles during commonly prescribed therapeutic exercises in subjects with and without shoulder muscle activity of the supraspinatus, infraspinatus, teres minor, and lower trapezius muscles during commonly prescribed therapeutic exercises in subjects with and without shoulder muscle activity of the supraspinatus, infraspinatus, teres minor, and lower trapezius muscles during commonly prescribed therapeutic exercises in subjects with and without shoulder muscle activity of the supraspinatus, infraspinatus, teres minor, and lower trapezius muscles during commonly prescribed therapeutic exercises in subjects with and without shoulder muscle activity of the supraspinatus, infraspinatus, teres minor, and lower trapezius muscles during commonly prescribed therapeutic exercises in subjects with and without shoulder muscle activity of the supraspinatus, infraspinatus, teres minor, and lower trapezius muscles during commonly prescribed therapeutic exercises in subjects with and without shoulder muscle activity of the supraspinatus, infraspinatus, teres minor, and lower trapezius muscles during commonly prescribed therapeutic exercises in subjects with and without shoulder muscle activity of the supraspinatus, infraspinatus, teres minor, and lower trapezius muscles during commonly prescribed therapeutic exercises in subjects with and without shoulder muscle activity of the supraspinatus, infraspinatus, teres minor, and lower trapezius muscles during commonly prescribed therapeutic exercises in subjects with and without shoulder.
pathology. SUBJECTS—Twenty healthy subjects (9 male, 11 female) and 20 subjects with recurrent unilateral shoulder pain and weakness (14 male, 6 female), aged 18 to 40 years (mean = 28, SD = 5.8), participated in this study. METHODS—Subjects performed each of the following exercises using a hand-held weight: prone lateral (external) rotation, sidelying lateral rotation, and arm elevation in the scapular plane. Indwelling fine-wire electrodes recorded electromyographic (EMG) activity during each exercise. The EMG activity in five phases of concentric contraction of each exercise was averaged and divided into three equal time intervals. Mean EMG values normalized to maximal activity for the entire phase of concentric contraction and for each of the three intervals were used in subsequent analyses. RESULTS—Two-way repeated-measures analyses of variance (ANOVAs) revealed between-group differences only in the prone lateral rotation exercise. Compared with subjects without shoulder pathology, subjects with shoulder pain showed significantly greater EMG activity in the infraspinatus muscle and less activity in the supraspinatus muscle during this exercise. CONCLUSION AND DISCUSSION—These results suggest that the pattern of muscle activation during specific shoulder movements in patients with shoulder pain may be related to pathology. Future studies are needed to determine whether an imbalance in neuromuscular control is a factor contributing directly to shoulder dysfunction or whether such an imbalance is secondary to some pathology.

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BACKGROUND AND PURPOSE—The purposes of this study were: 1) to examine the effects of a passive hip extension stretching exercise program on hip extension range of motion (ROM), 2) to examine the effects of a trunk flexor exercise program on trunk flexor muscle performance, and 3) to examine the effects of passive hip extension stretching or trunk flexor exercises on walking and running economy. (Gait economy is defined as the steady-state oxygen consumption per unit of body weight required to walk or run at a specified velocity.) SUBJECTS—Twenty-five healthy, athletic, male college students (mean age = 21 years, mean weight = 75 kg, mean height = 172 cm) were randomly assigned to one of three groups: a control group (n = 7), a hip extension stretching group (n = 9), or a trunk flexor exercise group (n = 9). METHODS—Before and after 3 weeks of intervention, the following measurements were obtained: right and left hip extension ROM, trunk flexor muscle performance, and gait economy. A three X two-way (groups X test sessions) analysis of variance (ANOVA) for repeated measures for unequal subject numbers was performed on each of the five dependent measures, with analysis of simple main effects applied when significant interactions were found. RESULTS—The ANOVA on right and left hip extension ROM revealed a significant interaction. Analyses of simple main effects showed that 3 weeks (six sessions) of passive hip extension stretching significantly improved right hip extension ROM (pretest = -20.4°, posttest = -8.3°) and left hip extension ROM (pretest = -16.8°, posttest = -7.0°). There also was a significant interaction for trunk flexor muscle performance. The analysis of simple main effects revealed that 3 weeks of daily trunk flexor exercises significantly improved trunk flexor muscle performance (pretest = 41.5°, posttest = 60.4°). The 3-week intervention program of hip extension stretching or trunk flexion exercises, however, did not produce significant changes in walking or running economy. CONCLUSION AND DISCUSSION—The results suggest that: 1) six treatment sessions of passive stretching were sufficient to improve hip extension ROM; 2) 3 weeks of exercises performed daily improved trunk flexor muscle performance; and 3) training of isolated tasks, such as hip flexibility or trunk strengthening activities, did not produce the desired outcome in the economy of walking or running. Possible reasons for the results are discussed.

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Bausch & Lomb Introduces the Industry’s First Sports Bag for Athletic Trainers

Bausch & Lomb, the eye care industry’s sports marketing leader, has introduced a Sports Bag for athletic trainers. The bag provides trainers with all the essential eye care equipment needed to care for an athlete’s sports-related eye injury or lost contact lens during competition.

The bag includes eyewash and eye patches, protective eye wear, and a log sheet to record each athlete’s prescription history. Other items in the Sports Bag include Bausch & Lomb’s ReNu Multi-Purpose contact lens care solution, eye drops, a mirror, pen lights, contact lens cases, an eyeglass screwdriver, cotton swabs, and bandage tape.

The bag is available nationally by calling Bausch & Lomb at 1-800-828-9030. It sells for $165.

Controlled Weight Bearing Without a Pool

Lift Aire Incorporated introduces the “MOONWALKER”, a self-contained system that produces a lifting force of up to 275 pounds. A smooth, constant force follows the patient’s movement while walking or jogging on a treadmill or other exercise equipment. Using well-proven technology, these units are highly reliable. The “MOONWALKER” represents a new generation of equipment designed to provide controlled weight bearing at a reasonable price.

For more information contact Lift Aire Incorporated at P.O. Box 3536, Kalamazoo, MI 49003-3536 or call 616-345-5400, toll free 1-800-795-0300.

Breakthrough Development of New Casts for Athletes

A new age of casting products for fracture and sprain management in athletics was ushered in with the announcement of the QuickCast™ Wrist Immobilizer, developed and manufactured by LANDEC Corporation of Menlo Park, Calif. The new wrist cast is a rigid sleeve that quickly heat shrinks to fit to the anatomy of the patient. The shrinkable and moldable casting system is the first in a proprietary advancement in materials developed by the company, which is launching a new generation of casting products for fractures, sprains, dislocations, and soft tissue injuries.

LANDEC’s first product was developed for wrist, thumb, hand, and lower arm injuries. The QuickCast Wrist Immobilizer is applied as a rigid sleeve over padding material. Then heat from an ordinary hair dryer is used, and as the sleeve warms, it begins to shrink and conform to the underlying anatomy within seconds. When the cast cools, it becomes rigid again.

For removal, the QuickCast is easily cut with scissors, a plus for athletic trainers who want to create a removable device.

For additional information on distribution, contact LANDEC Customer Service at (415) 261-3632.

Carapace, Inc Introduces the EnduraSplint2® Splinting System

EnduraSplint2 offers the strength of fiberglass without the mess! Our prepadded splints feature a soft polypropylene padding on the patient side with a low profile back cover that allows easy “no gloves” handling. EnduraSplint2 is available in both continuous rolls and pre-sized splints to expedite application, reduce handling and eliminate waste.

EnduraSplint2 Splinting System is indicated for all trauma and secondary splinting applications where quick rigid immobilization is desired.
One-sided polypropylene padding is “hydrophobic”; it sheds moisture faster and stays drier than open cell foam. “Breathability” is improved to reduce the possibility of maceration. The padded side provides a soft, comfortable surface, with superior protection from sharp edges. The non-padded side is a protective barrier of non-woven material laminated to highly breathable DuPont® Hytrel®. One-sided padding makes a lighter, lower profile splint that dries more quickly.

The 5-minute set time allows enough time for working and molding the splint, yet it sets quickly enough to provide security, with less chance of wrinkles or other pressure areas.

The 7-layer construction provides strength equivalent to other 8-layer splints, yet it’s lighter in weight and more comfortable.

For more information contact Carpace, Inc at 12626 E 60th St, Tulsa, OK 74146 or call 918-252-7266 (Fax: 918-254-0965).

ODOR-END Emergency Clean-up Kit

ODOR-END kits from Pioneer help prevent the spread of illness and cross contamination among athletes. Kits contain everything needed for fast, sanitary clean-up and disposal of vomit, blood, and other potentially infectious fluid spills. Kits feature ODOR-END powder, which turns up to 150 oz. of spilled fluid into a manageable, deodorized gel. Ideal applications for ODOR-END kits include: indoor practices, bus trips to and from games, gym classes, locker rooms, baseball and football games, and wrestling meets. Each single-use kit contains: Emergency Clean-up Powder, 1 pair seamless medical grade gloves, 2 water-resistant scoops, 2 large EPA Quaternary Germicidal Cloths, 1 antiseptic towelette, and disposal bags. Six kits per box.

For more information, contact Pioneer Manufacturing Co., 4529 Industrial Parkway, Cleveland, Ohio 44135 or call toll free 1-800-877-1500 (FAX 800-877-1511).

GERMOTOX® Athletic Strength Disinfectant/Deodorant

In thousands of training facilities across the country, GERMOTOX is used to help protect athletes against herpes simplex, staph infections, flu virus, salmonella, and infectious bacteria. When used on a regular basis, this broad spectrum phenolic disinfectant and deodorant has been proven effective at controlling the spread of athlete’s foot fungus.

Used in conjunction with Pioneer’s Mist Maker modified humidifier, GERMOTOX also makes an excellent deodorant; the air is “washed” and “purified”—not masked with perfumes like most deodorants. Because GERMOTOX is water-based, it will not stain fabrics or attack seams in equipment, mats, uniforms, or duffel bags. GERMOTOX is EPA registered and USDA accepted. Applications include athletic equipment, wrestling mats, training tables, lockers, helmets, showers, whirlpools, and uniforms.

For more information contact Pioneer Manufacturing Co., 4529 Industrial Parkway, Cleveland, Ohio 44135-0311 or call toll free 1-800-877-1500 (FAX 1-800-877-1511).

New Sully Shoulder Stabilizer Is Changing Opinions About Shoulder Braces

The Saunders Group, Inc., recently introduced the Sully™ Shoulder Stabilizer, an innovative product that breaks through the barriers of traditional shoulder brace stereotypes. Some shoulder braces provide more immobilization than stabilization, while others designed to allow function generally provide little, if any, true stabilizing protection. Coaches, trainers, therapists, and physicians are faced with a choice of either too much, or too little support. Now the Sully offers athletes something they’ve never had before: an effective combination of stabilization and functional movement.

The Sully is also unique because it is effective for all types of shoulder instabilities (anterior, inferior, posterior and multi-directional), as well as shoulder separations, muscle strains (eg, pectoral) and rotator cuff injuries. The device fits either the right or left shoulder and consists of a support with stabilization straps that
may be wrapped in a variety of configurations. The entire outside of the support is covered with hook-sensitive material, so the Velcro®-tabbed stabilization straps can be positioned anywhere on the support. This allows users to stabilize, assist, or restrict movement in any direction. Once positioned, the stabilization straps can be cut to the exact length needed. This allows the Sully to be custom-fitted for each athlete and application.

The Sully is constructed of perforated, breathable neoprene. On the inside, this rubber-like material contacts the skin directly. The support acts as a “second skin” that moves with the athlete. When the stabilization straps are applied, it is as if they are attached directly to the body. The support comes complete with one bifurcated neoprene strap, two 3" neoprene straps, Velcro attachments, a protective, closed-cell foam pad and anchor strap for use with shoulder separations, and an application guide. The stabilization straps are elastic so the restriction/assistance can be adjusted from very light to very strong.

The Sully was developed by Doak Ostergard, ATC, and named in honor of NATA Hall of Fame trainer George “Sully” Sullivan.

For more information on the Sully Shoulder Stabilizer, call 1-800-456-1289.

Cramer Introduces Biohazard Waste System

With the risk of exposure to blood-borne pathogens in athletics on the rise, Cramer has introduced a new Biohazard Waste Mailing System to help athletic trainers dispose of sharps, soiled bandages, and other biohazard wastes safely and conveniently.

The system is a cost-effective and legal method for trainers and coaches that requires no long-term contract or commitment. When the containers are full, trainers or coaches can mail the kits back to an approved waste disposal facility via US mail. This plant then destroys the waste at their incineration facilities, meeting all state and federal requirements for clean air and environmental standards.

The price includes all shipping and destruction costs, so there are no hidden charges or extra costs. The sender will even receive a final copy of the manifest tracking form, certifying the date and time the waste was treated and disposed.

Cramer’s Biohazard Waste Mailers are available in three sizes: a two-gallon container, a three-gallon container, and a one-gallon container, available in a set of three. Mailing boxes are also included and self-addressed.

For more information about Cramer’s Biohazard Waste Mailing System, call Cramer Products customer service at 1-800-345-2231.

Pelvic Exercise Set

Lodi, OH—Introducing the Model 7560 Pelvic Exercise Set from Bailey Manufacturing. This piece of equipment provides movement training and free supine pelvic motion for treatment of the low back and lumbar pelvic dysfunction.

Model 7560 provides optimum functional rehabilitation via concurrent application of active range of motion, muscle strengthening, muscle re-education, relaxation, and proprioception/kinesthetic awareness.

Pelvic motion achieved by both eccentric and concentric muscular contraction with smooth pivoting action, the board facilitates education of the anterior, posterior, and pelvic tilt exercise techniques.

The 12" and 16" boards are covered in vinyl, with the standard camel color. There is a 3" sphere with a 10° tilt; a 6" sphere with a 20° tilt; and a 8" sphere with a 30° tilt. The boards and spheres are interchangeable. The Model 7560 can be stored very easily and is suitable for use in the clinic, the training room, and the home.

For further information on the Model 7560 and copy of their catalog of rehabilitation products, contact Bailey Manufacturing at P.O. Box 130, Lodi, OH 44254 or call 1-800-321-8372 (Fax 216/948-4439).

Medical Science Products Introduces a New Size Single-use Electrode

Medical Science Products, Inc. has developed a new size disposable electrode to be used in conjunction with electro-therapy devices. The new stimulation electrode offers a breakthrough 2" x 6" size with a conductive surface area of 1" x 4" with the MSP center ridge pin connector or snap connector. Like the smaller version, the 2100P Conductor™ 2" x 2.75", this larger 2600P Conductor™ is made of special hypo-allergenic, solid hydrogel, which is self-adhering. It also has a flexible tan cloth backing which provides the patient with discrete pain treatment for the larger stimulation sites.

The 2" x 6" electrode is available in quantities of 4EA or 20EA per pack, whereas the 2" x 2.75" is available in 20EA or 40EA per pack. Besides packaging options and sizes, the electrodes provide users with many other benefits. They are durable enough to stand up to everyday activities such as light bathing and exercise, yet they are still gentle enough to allow the skin to breathe. The electrode...
needs no water, tape, or gel to be applied and can be worn for several days.

For more information, contact Medical Science Products, Inc., PO Box 381, Canal Fulton, OH 44614 or call 1-800-456-1971 (FAX 216-854-1953).

Cramer's Multi Wrap Customizes Cold Therapy

Cramer's new Multi-Wrap Cold Treatment System has been designed to be easily adaptable to treat any area of the body, adding maximum convenience and speed and potentially saving hundreds of dollars.

The Multi-Wrap is a complete system of new Cramer Multi-Flex segmented gel packs plus custom-tailored application wraps that quickly and effectively ice down shoulders, knees, thighs, ankles, backs, or any other body part of an injured athlete.

The Wrap features an outside layer of insulating neoprene to keep gel packs within the therapeutic temperature range longer. Hook and loop fasteners allow for quick fastening without fumbling for elastic wraps, tape or clips. Each wrap is partitioned to adjust the size of the treatment area for an individual athlete.

For more information about Cramer’s Multi-Wrap Cold Treatment system, call Cramer Products’ customer service at 1-800-345-2231.

Introducing the Biodex Stability System for Dynamic Assessment and Training of Neuromuscular Performance

Biodex Medical Systems has just released their new Stability System that addresses neuromuscular control by quantifying the ability to maintain dynamic unilateral postural stability on an unstable surface. The patient’s ability to control the platform’s angle of tilt is quantified as a variance from center. A large variance is indicative of poor muscle response.

Easy-to-follow prompts make the system simple to learn and use, leading the user step-by-step through testing and training protocols. The degree of surface instability is selected by the clinician and controlled by a microprocessor-based actuator. Because the Biodex Stability System permits up to 20° of support surface tilt, ankle joint mechanoreceptors are maximally stimulated, without causing excessive ankle displacement.

For effective neuromuscular training or to distract the patient from concentrating on balance, a game port interface converts the platform into a joystick and turns the system into an interactive video game. Patient’s motion controls the game for a variety of sports.

Featuring the latest in microprocessor and display technology, the Biodex Stability System lets you test and print a report in minutes. All test parameters are documented and included in a choice of several 8-1/2” × 11” formats.

For more information on the new Biodex Stability System, contact Biodex Medical Systems, Brookhaven R & D Plaza, PO Box 702, Shirley, NY 11967 or call 1-800-224-6339 (FAX: 516-924-9338).

New Black Ankle Brace From McDavid

The new 199BK Black Lightweight Ankle Brace from McDavid is a unique reduced weight brace that actually breathes for greater comfort.

Twenty-five percent lighter and less bulky than other laced ankle braces, the 199BK provides cooler, more comfortable, superior support. A padded Intera® lining and two layers of vented nylon/mesh fabric, plus spring steel stays stabilize the ankle and hold it firmly in place. Available in men’s and women’s sizes from XS to XL, the 199BK can be worn on either foot.

This lightweight ankle brace is just one of a full line of team-tested, laced-ankle braces in black or white available from McDavid.

For more information on the new Black 199BK Lightweight Laced Ankle Brace contact McDavid Knee Guard, Inc., 5420 W. Roosevelt Road, Chicago, IL 60650 or call 1-800-237-8254 (FAX: 312-626-7322).
ANOРЕXIA/BULIMIA


CERVICAL


FOOTBALL


FRACTURE


HEPATITIS-B


INJURY STATISTICS


LOWER EXTREMITIES


MOUTH


Lancaster DM, Ranalli DN. Comparative evaluation of college football officials’ attitudes toward NCAA mouthguard regulat...
MYOSITIS

OVERTRAINING

SPONDYLOLYSIS

Stress Fractures
Management Strategies in Athletic Training
Editors: Richard Ray, EdD, ATC
Human Kinetics Publishers, Champaign, IL
1994
256 pages
ISBN 0-87322-582-1
Price: $32.00

When I finished reading this book by Dr. Ray, two thoughts came to mind. First, where was this book years ago when I started my first position as a head athletic trainer?, and, second, this book will surely make it easier for students to prepare for the dreaded administration questions on the NATA certification exam. For years, athletic training textbooks have gone into great detail regarding prevention, evaluation, treatment, and rehabilitation of injuries, while only briefing us in the area of administration. In my opinion, this book is long overdue.

Ray’s book is divided into eight chapters, with each focussing on a different aspect of athletic training management. Chapter 1—“Why athletic trainers organize” provides a theoretical basis of managerial effectiveness. Chapter 2—“What athletic trainers do: program management” discusses vision statements, mission statements, and program evaluation. Chapter 3—“Who athletic trainers work with: human resource management” provides the reader with different types of organizational systems. It discusses the entire hiring process, including what should occur during an interview. Lastly, it addresses strategies for staff evaluation. Chapter 4—“What athletic trainers use: financial resource management” is an invaluable chapter dealing with such items as budget, inventory, and purchase of supplies. Chapter 5—“Where athletic trainers work: facility design and planning” takes the reader through a step-by-step process, beginning with the needs assessment and ending with monitoring of the construction. Ray shares important ideas about the layout and size of an athletic training facility, and how to choose an architect.

Chapter 6—“Helping athletic trainers remember: information management” deals with record keeping and how computers can assist this process. The author includes many sample forms for the reader. Chapter 7—“Helping athletic trainers pay the bills” shares information regarding athletic insurance. Ray presents the strengths and weaknesses of self-insurance, primary coverage, and the plan used by most institutions, secondary coverage. Third-party reimbursement and how athletic trainers fit into the picture is also presented. Chapter 8—“Protecting athletic trainers: legal considerations in sports medicine” is an invaluable chapter, providing definitions and examples of legal aspects in athletic training.

I recommend this text not only because it contains valuable information, but also because it is well-organized and well-written. Each chapter includes several case studies, a few at the beginning to stimulate thinking, and a few at the end to test our problem-solving skills based on what we learned in the chapter. In this way, Dr. Ray allows the athletic trainer to practice clinical skills dealing with administration. I find this comparable to the “hands-on” tests that injury evaluation texts provide the reader. The information is also easy to find. The author provides many illustrations to enhance what is written in the text. Through the use of illustrations, charts, sample forms, and case studies, Dr. Ray has presented his information in a way that should be understood by people of varied learning styles.

I can see how this book can be a valuable time-saver for athletic trainers and students of athletic training. For example, if you want information regarding only one or two aspects of management such as insurance or how to hire the right employee, you can turn to the appropriate section. This will also save time for the student who is preparing for the NATA exam and wishes to know more about the legal aspects of athletic training or inventory and ordering of supplies, etc. Although this well-organized book can be used as an excellent reference, I suggest you read it from cover to cover, when you find the time.

For too long, athletic trainers have not been adequately prepared in the science of administration and management, and, like me, have had to learn these tasks on the job. As I examined this book, I not only discovered how I could have avoided some of the administrative mistakes I have made, but I also uncovered many strategies to follow in the future that would make work more efficient and meaningful. As an educator, I now feel I have the tools to prepare my students not only for administration questions on the NATA exam, but also for the administrative tasks of their first job. This book is a must for athletic trainers in all settings and is valuable for the student. I feel that it should be mandatory reading for graduate education.

David O. Draper, EdD, ATC

YMCA Healthy Back Book
YMCA of the USA/Patricia Sammann
Human Kinetics Publishers, Champaign, IL
1994
110 pages, illustrated
ISBN: 0-87322-629-1
Price: $10.59

The purpose of this book is to promote self management of back pain through a comprehensive back program and a healthier lifestyle.

The focus of this book is to support low back pain (LBP) sufferers and to teach them to manage their
own condition during various stages of recovery.

The book is divided into six chapters. Chapter 1 provides good first-aid tips for those in the acute stage. Chapter 2 gives an overview of the various medical professionals who treat LBP without endorsing or condemning any one profession. It also prepares the reader for the first office visit. Chapter 3 overviews anatomy and function, common medications, and identifies risk factors. Chapter 4 nicely illustrates common exercises with a three-level progression back to normal activities of daily living.

Aerobic exercise, strength training, and aquatic exercise are endorsed and substantiated as important to long-term management. Chapter 5 gives an overview of posture and body mechanics. Chapter 6 introduces weight control, nutrition, and stress management techniques.

The strength of this book is in its diversity. A variety of relevant materials are introduced in an organized manner. One minor omission is a discussion of back orthoses and their role in the management of LBP.

This book is in no way specific to athletics. It is similar to other self-management books such as McKenzie’s *Treat Your Own Back* but avoids being loyal to one specific philosophy. Flexion and extension principles are employed with instructions to discontinue any exercise that aggravates symptoms.

I would recommend that athletic trainers obtain and keep a few copies of this book in their work environment. It would be a very useful book to lend to acute or chronic LBP sufferers when they come to you in a time of need.

Bob Stahara, ATC, PT
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 “Author’s 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, 1995. 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, 1995.

NATA Student Writing Contest  
Deloss Brubaker, EdD, ATC  
Life College  
1269 Barclay Circle  
Marietta, GA 30060
1993 Outstanding Manuscript Awards

Congratulations to the following authors. The Editorial Board selected the following seven manuscripts for special merit from among those published in the Journal of Athletic Training during 1993. Good work, folks!

Outstanding Research Article:

**Winner:** Merrick MA, Knight KL, Ingersoll CD, Potteiger JA. The effects of ice and compression wraps on intramuscular temperatures at various depths. 1993;28:236.


Outstanding Clinical Article:


**First Runner-up:** Bunton EE, Pitney WA, Kane AW, Cappaert TA. The role of limb torque, muscle action and proprioception during closed kinetic chain rehabilitation of the lower extremity. 1993;28:10.

**Second Runner-up:** (tie) Feld F. Management of the critically injured football player. 1993;28:206.

PREVIOUS OUTSTANDING MANUSCRIPT AWARD WINNERS

1992

Outstanding Research Article:

**Winner:** Denegar CR, Perrin DH. Effects of transcutaneous electrical nerve stimulation, cold, and a combination treatment on pain, decreased range of motion, and strength loss associated with delayed onset muscle soreness. 1992;27:200.

**First Runner-up:** Paris DL. The effects of the Swede-O, New Cross, and McDavid ankle braces and adhesive ankle taping on speed, balance, agility, and vertical jump. 1992;27:253.

**Second Runner-up:** Moss RI, DeVita P, Dawson ML. A biomechanical analysis of patellofemoral stress syndrome. 1992;27:64.

Outstanding Clinical Article:


**First Runner-up:** Keskula DR, Tamburello M. Conservative management of piriformis syndrome. 1992;27:102.

1991

Outstanding Research Article:

Winner: Varpalotai M, Knight KL. Pressures exerted by elastic wraps applied by beginning and advanced student athletic trainers to the ankle and the thigh with and without an ice pack. 1991;26:246.


Outstanding Clinical Article:


Second Runner-up (Tie):
Smith AN, Bell GW. Hypertrophic cardiomyopathy and its inherent danger in athletics. 1991;26:319.

1990

Outstanding Research Article:


Outstanding Clinical Article:


Outstanding Research Article:

**Winner:** Pawlowski D, Perrin DH. Relationship between shoulder and elbow isokinetic peak torque, torque acceleration energy, average power, and total work and throwing velocity in intercollegiate pitchers. 1989;24:129.

**First Runner-up:** Duffley HM, Knight KL. Ankle compression variability using the elastic wrap, elastic wrap with a horseshoe, Edema II Boot, and Air-Stirrup brace. 1989;24:320.

**Second Runner-up:** Zemper ED. Cerebral concussion rates in various brands of football helmets. 1989;24:133.

Outstanding Clinical Article:

**Winner:** Denegar CR, Saliba E. On the field management of the potentially cervical spine injured football player. 1989;24:108.

**First Runner-up:** Gieck JH, Foreman SA, Saliba EN. Evaluation and correction of common postural dysfunctions in the athlete. 1989;24:310.

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Authors’ Guide

(Revised February 1992)

The Journal of Athletic Training welcomes the submission of manuscripts that are of interest to persons engaged in or concerned with the progress of the athletic training profession (athletic injury prevention, evaluation, management, and rehabilitation; administration of athletic training facilities and programs; and athletic health care counseling and education). Manuscripts should conform to the following:

SUBMISSION POLICIES
1. Submit one original and three copies of the entire manuscript (including photographs, artwork, and tables) to the editor.
2. All manuscripts must be accompanied by a letter signed by each author, and must contain the statements below. By signing the letter, the author(s) agrees to comply with all statements. Manuscripts that are not accompanied by such a letter will not be reviewed. "This manuscript contains original unpublished material that has been submitted solely to the Journal of Athletic Training, is not under simultaneous review by any other publication, and will not be submitted elsewhere until a decision has been made concerning its suitability for publication by the Journal of Athletic Training. In consideration of the NATAs taking action in reviewing and editing my (our) submission, the author(s) understands hereby transfers, assigns, or otherwise conveys all copyright ownership to the NATAs, in the event that such work is published by the NATAs."
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STYLE POLICIES
7. The active voice is preferred. Use the third person for describing what happened. "I" or "we" (if more than one author) for describing what you did, and "you" or the imperative for instruction.
8. Each page must be typewritten on one side of 8.5 x 11 inch plain paper, double spaced, with one-inch margins. Do not right justify pages.
9. Manuscripts should contain the following, organized in the order listed below, with each section beginning on a separate page:
   a. Title page
   b. Acknowledgements
   c. Abstract and Key Words (first numbered page)
   d. Text (body of manuscript)
   e. References
   f. Tables—each on a separate page
   g. Legends to illustrations
   h. Illustrations
10. Begin numbering the pages of your manuscript with the abstract; page numbers must then, consecutively number all successive pages.
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 principal reason for the report, it should be in the title. Otherwise, it should appear in the abstract page as #1; then, consecutively number all successive pages.

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 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 research, and the body of the author’s summary and/or conclusions. It is unacceptable to state in the abstract words to the effect that “the significance of the information is discussed in the introduction.” 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 come after the abstract and following your abstract. For Tips From the Field, the key words should 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 stated and developed. Tell why the study needed to be done or the article written and culminate with a statement of the problem (or controversy). Highlights of the most prominent works of others as related to your subject 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 major points and significance of the controversy, pointing out differences between others’ results, conclusions, and/or opinions. The introduction is not the place for great detail; state the facts in brief specific statements and reference them. The detail belongs in the discussion. Also, an overview of the manuscript is part of the abstract, not the introduction.
16. The body of the manuscript varies according to the type of article (examples follow); however, 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 figures is recommended.
17. a. The body of the manuscript 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 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 were...”), medical history (surgery, laboratory results, exam, etc.), diagnosis, treatment and clinical course (rehabilitation until and after return to competition), criteria for return to competition, and deviation from 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 with 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 the 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.
18. This page number 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 (italicized 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.
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This CEU Credit Quiz contains questions drawn from the following articles:
Courtney KS. Athletic trainers can impact health promotion and disease prevention.
Martin DE. Emergency medicine and the underage athlete.
Moss CL. 1992 Entry-level athletic trainer salaries.
Schlabach G. Carbohydrate strategies for injury prevention.

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Instructions
1. Photocopy these pages and write on the copy.
2. Read the articles listed above.
3. Answer the questions.
4. Mail with $15 fee (checks made payable to Indiana State University) postmarked by December 15, 1994, to:

JAT—CEU Quiz
Physical Education Department
Indiana State University
Terre Haute, IN 47809

Answers to June ’94 CEU Quiz
Volume 29, Number 2
1. c 4. a 7. d 10. a 13. a
2. d 5. a 8. a 11. e 14. e
3. d 6. a 9. e 12. b 15. a
Circle the correct answer.

1. The main reason given for anabolic steroid use in a study of high school students was:
   a. to improve appearance.
   b. to treat a sports injury.
   c. to enhance performance.
   d. peer pressure.
   e. None of the above.

2. The emergency medicine doctrine for minors:
   a. states that no minor may receive medical care without parental consent.
   b. states that medical treatment may be administered when emergency situations exist when delaying treatment to first secure parental consent would endanger the life or health of a minor.
   c. is present in most state statutes to deal with consent for emergency medical care.
   d. All of the above.
   e. b and c only.

3. The effects of ankle braces upon agility course performance in high school athletes were shown to:
   a. be directly influenced by the athlete's perceived comfort, support, and performance restriction.
   b. not be influenced by the athlete's perceived comfort, support, and performance restriction.
   c. greatly affect agility.
   d. have limited effect upon agility.
   e. Both a and d.

4. The athletic trainer can participate in the development of the Year 2000 health objectives by:
   a. promoting fitness.
   b. decreasing injuries.
   c. supporting the fight against tobacco and alcohol.
   d. All of the above.
   e. a and b only.

5. A study of 1992 entry-level athletic trainer salaries showed that:
   a. college/university salaries were higher than high schools.
   b. hospital/clinic salaries were the highest.
   c. high school salaries were the highest.
   d. hospital/clinic salaries were the lowest.
   e. college/university salaries were higher than hospital/clinics.

6. Muscle glycogen:
   a. depletion is associated with fatigue, but not injury.
   b. stores are derived almost entirely from carbohydrate intake.
   c. is the predominant fuel in exercise of moderate to severe intensity.
   d. All of the above.
   e. b and c only.

7. A study on job marketability in selected Midwestern states showed that:
   a. the NATA athletic trainer would decrease his/her likelihood of being hired if he/she was also teacher-certified.
   b. most clinics would not hire an NATA-certified athletic trainer if that individual was also licensed as a physical therapist.
   c. multiple duty/multiple certification qualifications are unimportant to high school employment.
   d. the athletic trainer desiring employment in a public school should have NATA certification, a teaching major in physical education, math, or science, and a secondary teaching endorsement.
   e. both c and d.

8. The primary sources for obtaining anabolic steroids given by high school students was:
   a. teammate/friend.
   b. teacher/coach.
   c. physician/pharmacist.
   d. black market.
   e. veterinarian.

9. Advantages of the modified Lachman test over the Lachman test are:
   a. the modified Lachman does not require two examiners to perform the test.
   b. the modified Lachman requires less dependency on the size and/or strength of the evaluator's hands.
   c. the modified Lachman can be performed at an athletic training facility as well as at sports competition.
   d. All of the above.
   e. a and c only.

10. Factors to consider in muscle glycogen resynthesis include:
    a. since resynthesis has a faster rate immediately following a workout, carbohydrates should be consumed very soon after exercise.
    b. more than 50 g of carbohydrates immediately after a workout enhances resynthesis.
    c. fructose produces a fast rate of resynthesis.
    d. beverages have an advantage over foods in resynthesis.
    e. All of the above.

11. When providing emergency medical care to minors:
    a. lack of parental consent can limit the provision of necessary medical care to prevent damage to the life or health of a minor.
    b. the mature minor may be authorized to provide consent for medical care but would not be responsible for medical costs.
    c. medical care could be provided if someone were authorized to act en loco parentis (in the place of parents and/or legal guardians).
    d. consent need not be obtained if an emergency is not present.
    e. All of the above.

12. Use of a functional elbow brace on a medial elbow ligament sprain:
    a. resulted in less medial displacement in the injured collateral ligament.
    b. resulted in restored medial stability to the elbow joint.
    c. offered support to the elbow in sport-specific patterns.
    d. Both a and c.
    e. Both b and c.

13. When performing the modified Lachman test for ACL injury:
    a. the athlete must be lying prone on an examination table.
    b. the lower leg must be at approximately 45° of flexion.
    c. the examiner must remember that an athlete with a large calf muscle will present problems in performing this test.
    d. the examiner should know that results of this test will be similar to the Lachman test, but not exactly the same.
    e. All of the above.

14. The study on anabolic steroid use revealed that:
    a. use among basketball players was equal to that of wrestlers.
    b. many users are nonathletes; thus, the entire student population should receive anabolic steroid education—not just athletes.
    c. some users begin at the age of 10 or younger.
    d. teacher/coaches are a source for obtaining steroids for some.
    e. All of the above.

15. The relationship between fatigue and injury:
    a. is unclear and can’t be examined or proven.
    b. is unlikely.
    c. has been supported by investigations that suggest that fatigue may result in the substitution of movement patterns, exposing untrained musculature and joints to injury.
    d. is probably more of a direct, rather than an indirect, relationship.
    e. a and b only.
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