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Degrees and Credentials

There is much variability and inconsistency within the NATA concerning the use of abbreviations to signify degrees and credentials. I won’t try to speculate on the reason for this variability, but I would like to share some food for thought.

My thoughts have resulted because of a need for consistency in the Journal of Athletic Training, and because I serve on the credentials committee of another professional organization where we were charged with recommending how the credential offered by that organization should be written.

“Degree” has many meanings and stems from a multitude of languages. Its use in education stems from old French and means a step or rank. It is a “rank given by a college or university to a student who has completed a required course of study or to a distinguished person as an honor.”

“Credential” stems from the Latin word credere, which means “to believe or put trust in.” It often is used as a noun to refer to “that which gives credit, that which entitles to credit, confidence, etc; . . . a letter or certificate given to a person to show that he has a right to confidence or to the exercise of a certain position or authority.” Credential is from the same root as credible, which means one is “believable, entitled to belief or trust, trustworthy, reliable . . . .”

Degrees and credentials are used extensively in the medical profession to help identify a person’s training and authority. The common practice is to abbreviate credentials following your name. Do you indicate all degrees and credentials you have earned? In what order should you list them? Do you use them with or without periods? Following are the policies of the Journal of Athletic Training, and the reasons we adopted them.

1. Academic degrees should be written before credentials. For example, write MS, ATC, never ATC, MS.

2. Use only the highest academic degree, unless they are in totally different fields. For instance, a person with a BS in health or physical education who obtains an MS in physical education should not use MS, BS. One who has earned an MS in clinical psychology and a PhD in epidemiology, however, could use both initials, MS, PhD.

3. Abbreviate both degrees and credentials without the periods (AMA Manual of Style, section 11.1).

4. List credentials in the order of difficulty of obtaining them. For instance, ATC should be written before EMT, because the ATC requires a college degree and a minimum of 800 hours of clinical experience whereas the EMT does not require a college degree and requires less than 200 clock hours of course work and clinical experience.

5. When credentials are of similar difficulty, list them in chronological order. This would be the case for someone with both PT and ATC credentials, because both require a BS degree and have similar requirements for number of courses and hours of clinical experience.

Author/Reviewer Workshops to be Held at the NATA Annual Meeting and Clinical Symposium

Attention Peer Reviewers or Hopefuls:
Anyone who would like to increase their expertise in reviewing professional manuscripts is invited to a Peer Reviewer Workshop in connection with the Journal Committee meeting in Denver, CO, on Tuesday, June 2, 1992, at 2 pm.

Attention Authors:
As part of the Writers’ Workshop on Wednesday, June 3, 1992, you will have an opportunity to discuss your manuscripts and/or manuscript ideas with individual members of the Editorial Board. Bring your manuscript ideas or manuscripts (no matter how polished) to this session, which is being held from 2 pm to 6 pm.
ABSTRACT: Piriformis syndrome is a questionable clinical entity that has been cited as a cause of buttock pain and sciatica. The intimate relationship between the piriformis and the sciatic nerve has been suspected as being the source of the signs and symptoms that often appear following minor trauma to the pelvic or buttoc region. Muscle function is an important consideration in the evaluation and treatment of the athlete with suspected piriformis syndrome. The action of the piriformis muscle on the hip varies as the hip moves from a neutral to a flexed position. While in a flexed position, the piriformis internally rotates and abducts the hip; however, in a neutral position, the piriformis acts as an external rotator of the hip. A comprehensive evaluation provides the information necessary to design a treatment plan specific to the involved structures, while meeting the functional needs of the individual athlete. This paper describes the anatomy, pathomechanics, physical examination, and treatment options relevant to the piriformis syndrome. Treatment protocols stressing exercises that promote strength, flexibility, and functional activities are believed to be essential in restoring the athlete's ability to return to pain-free competition.

Incidence/Etiology

The incidence of piriformis syndrome has been reported to be six times more prevalent in females than males (11). While no dominant etiological factors have been reported, piriformis syndrome often occurs following a minor trauma to the buttocks or pelvis (1,2,12). The trauma is thought to precipitate a spasm of the piriformis muscle, which subsequently inflames the adjoining sciatic nerve (2). Piriformis syndrome has typically been characterized by symptoms consistent with irritation of the sciatic nerve. Isolating the dysfunction to this region usually follows exclusion of the more common causes of buttock pain and sciatica. More specifically, complaints of buttock pain with distal referral of symptoms are not unique to piriformis syndrome. Similar symptoms are prevalent with the more clinically evident lower back pain syndromes and pelvic dysfunction. Thus, a thorough evaluation of these regions must be performed to exclude underlying pathology.

Anatomy

The key elements of the piriformis syndrome are the anatomical relationships of the piriformis muscle to the sciatic nerve. The piriformis muscle arises from the pelvic surface of the sacrum, the greater sciatic notch, and the sacrotuberous ligament. The lower attachment is the superior border of the greater trochanter of the femur. The piriformis muscle passes over the sciatic nerve in the majority of cases. However, variations in this arrangement have been reported with the nerve crossing above or through the muscle belly itself (3,4). The typical relationship of the sciatic nerve and the piriformis is presented in Fig 1.

Some think that the piriformis can become hypertrophied or can spasm, resulting in compression of the nerve against the ischium, or, more specifically, against the bony edge of the sciatic notch (3). It also has been suggested that an accentuated lumbar lordosis and hip flexor tightness predisposes one to increased compression of the sciatic nerve against the sciatic notch by a shortened piriformis (7). Although differences in the anatomical relationships are helpful to facilitate understanding the mechanism of dysfunction, these differences do not affect conservative treatment strategies.

The piriformis muscle primarily is innervated by the S1 and S2 spinal nerve segments via the sacral plexus. The sciatic nerve is derived from the same spinal segments with contributions from the L4, L5,
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The piriformis is an external rotator of the hip and functions in conjunction with the quadratus femoris, obturator externus, obturator internus, and the gemellus superior and inferior. The rotary component of this muscle group has been reported to decrease with flexion of the hip (9). At 90° hip flexion, this group of muscles has a significant abductor component. Some report that the piriformis functions as an internal rotator in hip flexion (5,15). The function of the piriformis at varying joint angles is an important consideration for the clinician who is evaluating and treating piriformis syndrome.

**Evaluation**

The diagnosis of piriformis syndrome is primarily a clinical determination; therefore, a thorough history must be taken, and a careful, comprehensive physical exam must be performed. Establishing a systematic routine of evaluation not only facilitates gathering objective information from the examination, but it ensures that significant factors are not overlooked. The evaluation of the spinal neuromusculoskeletal system is summarized in the Table.

**Subjective Evaluation**

Obtaining a thorough medical history from the athlete is an integral component of the evaluation. It serves to enhance the physical assessment process by providing insight for the clinician to use to better focus on the relevant signs and symptoms. The subjective evaluation should be directed toward determining causative factors, such as a history of a recent trauma, or changes in training regimen or lifestyle. Information regarding the location, intensity, behavior, and frequency of pain will assist in directing the clinician during the evaluation. Generally, individuals with piriformis syndrome will report deep pain that is localized to the posterior aspect of the hip and is accentuated with standing or activity. This discomfort often lessens when the patient is lying down. Also, flexion of the knees may further moderate the symptoms. Pain, numbness, and paresthesia radiating distally into the lower extremity may be encountered; however, these symptoms frequently are present with lumbo-pelvic dysfunctions as well. Therefore, it is crucial that you extend the exam to these regions to rule out associated lumbar or sacroiliac dysfunction.

**Objective Evaluation**

The objective evaluation must encompass an assessment of active and passive range of motion of the spine and lower extremities, as well as muscle strength and posture. Palpation of the area is necessary to delineate the specific tissues involved. Several provocation tests have been suggested to differentiate piriformis syndrome from other types of dysfunction and will be discussed later. In addition, a neurovascular assessment is necessary to rule out more severe spinal pathology. The evaluation also should include assessment of functional and sport specific abilities to allow the clinician to clearly define the athlete’s functional limitations.

**Range of Motion**

Qualitative and quantitative assessment of the mobility of the piriformis muscle is an important component of the evaluation. Passive internal rotation of the hip while in 0° flexion may be painful, with limitation of motion secondary to pain and spasm. Passive external rotation and adduction while the hip is flexed to 90° would also be expected to be limited and painful. Saunders (14) suggests a clarifying test for assessing sciatic nerve entrapment by the piriformis. He advocates that when a straight leg raising test is positive for buttck pain, you should then externally rotate the extremity to see if the symptoms diminish. A lessening of symptoms is purported to be confirmation that the piriformis muscle is impinging on the sciatic nerve.

**Strength**

The conventional manual muscle test for the external rotators, including the piriformis, is carried out while the patient is sitting (6). The test position is represented in Fig 2. However, testing hip rotation in this position may provide misleading information about the status of the piriformis and other internal rotators (9), because, in hip flexion, the piriformis acts as an internal rotator. The correct manual muscle test for the piriformis with the hip flexed to 90° would be resisted internal rotation. Also, test the piriformis as an external rotator with the hip in 0° flexion as the patient lies on his or her side or is prone

---

**Evaluation of the Spinal Neuromusculoskeletal System**

1. Observe the athlete’s gait, stance, and sitting posture/position.
2. Take a thorough history of the sequence and nature of the problem.
3. Examine the structure and posture.
4. Assess the range of motion and muscle length, qualitatively and quantitatively.
5. Assess strength, qualitatively and quantitatively.
6. Palpate to determine the tension, texture, and temperature of the tissue.
7. Perform neurological assessment: deep tendon reflexes, myotome screening, sensation, and special tests.
9. Examine X-rays, CT scans, and reports.
10. Define problem areas.
11. Establish short- and long-term goals.
12. Develop treatment strategies to meet goals.
13. Reassess to determine effectiveness of the treatment program.

---

**Fig 2.—Conventional manual muscle test position to assess the external rotators of the hip including the piriformis muscle (Adapted from Kendall (6))**
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Testing hip rotation in both neutral and flexed positions provides you with a more comprehensive clinical picture of muscle performance. However, you can locate the piriformis muscle difficult to palpate because of the depth of the muscle and the often large mass of overlying muscle and soft tissues. Nonetheless, you can locate the piriformis muscle in the prone athlete using deep palpation. If a line were drawn from the posterior superior iliac spine (PSIS) to the greater trochanter, and an intersecting line were drawn from the anterior superior iliac spine (ASIS) to the ischial tuberosity, the piriformis muscle would lie where the lines cross (Fig 5) (10).

Functional Abilities

The athlete with piriformis syndrome may exhibit functional limitations; however, it is the pain that restricts activity or limits normal function. Difficulty may be encountered when moving the leg outside a car to stand up, moving laterally while in a sitting position, and maintaining balance on a movable surface. Sport-specific limitations may be present and must be evaluated to further enhance the clinical decision-making process.

Treatment

Treatment options for piriformis syndrome focus around the subjective and objective findings of the assessment. In most circumstances of piriformis syndrome, an inflammatory response is suspected in the muscle and/or sciatic nerve. Therefore, the treatment goals are directed initially toward decreasing inflammation, associated pain, and spasm, if present. Treatment options may include rest, cryotherapy, gentle pain-free stretching exercises, and electrical modalities. Heating modalities often are useful later in the rehabilitation process, when more vigorous stretching exercises are necessary. These modalities are beneficial because soft tissue elongation seems to be facilitated by the application of heat (18).

Exercise is perhaps the optimal means of managing this disorder. Active exercise, passive stretching, soft tissue mobilization, and proprioceptive neuromuscular facilitation (PNF) techniques are particularly effective in moderating the symptoms and restoring range of motion. Fig 6 illustrates specific exercise techniques that promote lengthening and relaxation of the piriformis muscle, facilitating the restoration of pain-free range of motion. The exercises are easily adapted for use in the clinic or as a component of the home exercise program. When incorporating these techniques into a plan, the clinician must remember the internal rotation and abduction function of the piriformis in the flexed hip. Therefore, the direction to stretch the
muscle should be opposite to that used with the hip in a neutral position.

The intensity, frequency, and duration of the exercise regimens are determined by the tolerance of the athlete. Initially, a practical guideline for active exercise includes few repetitions (ie, five to ten) performed in three sets, two to three times daily. Once a base level of exercise tolerance is established, the exercise program is progressed as tolerated. More aggressive stretching methods, including contract-relax PNF techniques, can be employed in the sub-acute phase.

Soft tissue mobilization may be integrated into the treatment plan to further enhance soft tissue extensibility. The athlete is positioned in a prone position with a pillow under the abdomen. Apply gentle pressure to the piriformis muscle with the heel of your hand in a medial, superior direction. You may flex the athlete’s knee to 90° and passively internally and externally rotate the hip at a slow speed. This technique may be contraindicated in athletes with knee pathology because it places increased stress on the knee joint during rotation of the hip.

You also may use modalities to facilitate relief from exercise-induced soreness and may begin additional exercises to stretch other shortened muscle groups (such as the hip flexors) at this point. Strength deficits in the piriformis and surrounding pelvic musculature also must be addressed in the rehabilitation program. Usually a progressive strengthening program for the piriformis may be initiated early in the rehabilitation plan. Strengthening of the piriformis should be carried out with the hip in a flexed position, emphasizing abduction and internal rotation, as well as in a neutral position addressing external rotation. Resistance may be provided manually with cuff weights, or using rubber tubing. Entry-level exercises designed to strengthen the piriformis are presented in Fig 7.

To facilitate strength gains while minimizing adverse symptoms, the strength program should begin with few repetitions and little resistance. The athlete should progress based on his or her tolerance to the exercise. Strength training also might include the use of PNF diagonal patterns, specifically D2 flexion and D2 extension patterns (13,17).

Functional activities are an integral component of the rehabilitation program. Proprioceptive, balance, and coordination activities are introduced when the necessary mobility and strength elements become evident. Progressing from controlled mobility activities (distal component fixed) to skill activities (distal component free) provides the clinician with a myriad of treatment options to meet the specific goals of the athlete. Consult the work of Sullivan, et al (16) to expand your knowledge of the stages of motor control and its application to the rehabilitation of piriformis syndrome. As basic activities are tolerated, sport-specific skills may be introduced.

A home exercise program is an integral component of the overall rehabilitation program. Consider independence and compliance with the program in planning short-term objectives. Providing the athlete with clear and concise illustrated instructions should promote independence and compliance with the exercise regimen.

Additional treatment options may include stretching the piriformis muscle. When the hip is flexed, the athlete applies pressure into adduction, as in A and B, or external rotation, as in C and D, to stretch the piriformis.

To further enhance soft tissue extensibility, the athlete is positioned in a prone position with a pillow under the abdomen. Apply gentle pressure to the piriformis muscle with the heel of your hand in a medial, superior direction. You may flex the athlete’s knee to 90° and passively internally and externally rotate the hip at a slow speed. This technique may be contraindicated in athletes with knee pathology because it places increased stress on the knee joint during rotation of the hip.

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include education with respect to body mechanics and posture, activity modification, and use of foot orthotic devices. In cases where conservative measures fail, injection of the piriformis muscle with a steroid has been advocated, with surgical resection being reserved for the most recalcitrant cases (1,2,11).

Summary

Piriformis syndrome is both a diagnostic enigma and a questionable clinical entity touted as a cause of buttock and lower extremity pain. While piriformis syndrome is not frequently encountered in the sports medicine setting, a basic understanding of the relevant anatomical relationships, evaluative techniques, and treatment options is necessary to effectively manage the athlete who presents with symptoms suggestive of piriformis syndrome.

References

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The Effects of a Warm-up on Acute Hip Joint Flexibility Using a Modified PNF Stretching Technique

William L. Cornelius, PhD  
Mary R. Hands, MS, RN

ABSTRACT: This study was conducted in order to determine the effects of various types of warm-up on performance of the slow-reversal-hold-relax modified Proprioceptive Neuromuscular Facilitation (PNF) flexibility maneuver. The subjects for this study (N=54) were active, injury-free females who were randomly assigned to stationary cycling, whirlpool, or control groups. Each group participated in its assigned treatment for 20 minutes and did not perform any stretching exercises before or during their warm-up. Acute flexibility data were collected for hip flexion with the use of a Leighton Flexometer following the treatment condition. Hip range of motion (ROM) did not differ between the groups performing a warm-up and the control group; therefore, a warm-up had no effect on hip ROM when using a modified PNF technique.

Flexibility is an important component of any fitness or conditioning program and can be developed and maintained through stretching exercises. One of the main uses for flexibility exercise in these programs is to improve joint range of motion (ROM). Flexibility exercise is simply an integral part of the total conditioning program, which enables an individual to reach his or her athletic potential. Adequate tissue extensibility is essential in improving the performance of many skills (1,12) and may reduce the quantity and/or extent of musculotendinous injuries (1,4,10,12). Therefore, use of effective flexibility procedures is essential in contemporary sports programs. Modified Proprioceptive Neuromuscular Facilitation (PNF) stretching techniques increase ROM better than the more common (passive, static, and ballistic) flexibility maneuvers (6-9,11,18,23). However, there are unanswered questions and confusion regarding ROM procedures (1,3-5,20,27). This investigation was conducted to determine whether a warm-up would influence hip ROM using a modified PNF technique.

Stretching generally is recommended after a brief warm-up in which the body temperature has increased slightly and perspiration has begun (19). A minimum of 5 minutes of light muscular exercise (walking, jogging, or cycling) will increase tissue temperature, making stretching both safer and more productive (19). A warm-up may consist of active or passive movements. It may prepare the body physiologically for subsequent physical activity, guarding against unnecessary musculoskeletal injury and possible muscle soreness (1). An active warm-up incorporates voluntary muscle activity in which general movement patterns are performed. A passive warm-up involves increasing soft tissue temperature through external means. A general, active warm-up entails a variety of movements that increase the core temperature of the body, and it is not necessarily related to the specific task for which the athlete is preparing. Muscular activity such as jogging, brisk walking, or cycling can increase blood flow to the muscles, which results in an increased intramuscular temperature (19). An example of a passive warm-up is submersion in a whirlpool. Heat transfer occurs in a whirlpool bath through convection in conjunction with a controlled water temperature (14,17) within a therapeutic temperature range of 104°F to 113°F (14,15,17,24,25) for approximately 20 minutes (14,15). A passive warm-up, however, is believed to be less likely to warm the deep muscles and could be counterproductive, because it diverts a large amount of blood to the skin rather than to the muscles (1).

Methodology

The sample for this acute flexibility investigation consisted of physically active, healthy, female volunteers (N=54) from the Downtown Dallas, TX, YMCA. The subjects selected were between the ages of 23 and 38, free from any known injuries or disabilities to the hip and legs, and within normal percent body fat limits (equal to or below 23%).

All subjects received a three-site body fat analysis (2), measured with Lange Skinfold Calipers prior to flexibility testing. This was done to ensure that body fat would not be an influential factor in altering the effects of a warm-up. Subjects meeting all selection criteria were invited to participate in the study on a voluntary basis and were given the opportunity to withdraw from the study at any time. An informed consent was signed by all subjects.

Subjects were randomly assigned to one of three groups: (1) passive warm-up (whirlpool); (2) active warm-up (stationary cycling); and (3) no warm-up (control). Consistent with accepted hydrotherapy procedures, subjects receiving the whirlpool treatment were submerged to a depth of water that was between 106°F and 110°F for 20 minutes (19). The water temperature was checked prior to the submersion of each subject. No stretching was allowed prior to the warm-up. A therapeutic effect is reached after 20 minutes in the
The subjects in the stationary cycling group were properly positioned on a Schwinn DX-9 Stationary Cycle with their legs extended to the pedal, with a slight bend in the knees. Subjects pedaled for 20 minutes at a heart rate of 105 to 115 beats per minute. Their heart rates were monitored.

The control group subjects did not warm up and were to refrain from any stretching or exercise prior to testing. They simply rested 20 minutes before being tested.

Subjects were tested for hip ROM with knee extension, using the Leighton Flexometer. Leighton (16) reports that reliabilities for right and left hip flexion with the Flexometer are 0.978 and 0.995, respectively. Data were collected for three slow-reversal-hold-relax trials for each subject after their warm-up, resting for 2 minutes between each trial. An average was calculated for the three trials and served as the data point.

All testing was performed on the dominant leg, which was determined by having each subject kick a ball. Flexibility testing began with the subject supine on a table. The slow-reversal-hold-relax flexibility technique consisted of a series of maneuvers beginning with an examiner performing a passive stretch on the subject to a point of tension behind the knee (popliteal fossa). The subject was instructed to verbally cue the examiner when she felt tension, not pain. The subject followed with a 4-second progressive buildup to a 6-second maximum voluntary isometric contraction of the hip extensors. A metronome was used to assist in counting the contraction time. The subject pushed her leg against the shoulder of the examiner during the contraction and then was told to relax while the stretch was maintained (Fig 1). A concentric contraction of the hip flexors followed. The subject was asked to move the leg without assistance into hip flexion while maintaining knee extension. The slow-reversal-hold-relax technique ended with a passive stretch performed by the examiner to the point where the subject felt tension behind the knee (18).

All measurements were taken at a terminal position of hip flexion during a passive stretching maneuver. The one-factor research design included three warm-up conditions. Data were analyzed with an analysis of variance (ANOVA) (28). The reliability of the data was calculated using intraclass correlation procedures.

Results
Descriptive statistics of the data were determined for anthropometric and flexibility parameters. The means and standard deviations for the three groups for age, height, weight, and body composition were 30.4±4.2 yr, 65.6±2.5 in, 126.7±12.7 lb, and 20.4±2.5% fat, respectively. Flexibility means and standard deviations for the three slow-reversal-hold-relax trials in degrees for each group were 124.0±11.0° (whirlpool), 127.6°±16.6° (exercise), and 118.9°±10.8° (control).

There was no significant difference between the conditions of the warm-up (F(2,51)=1.09, p=.34). Furthermore, the reliability of the ROM test-retest data was r=0.95 to r=0.97, indicating a high degree of true score variation.

Discussion
The modified PNF stretching technique can be a very effective technique for athletes who are attempting to increase the ROM of their joints. Although there are stretching techniques that take slightly less time, and flexibility maneuvers that require less supervision, there are no scientifically substantiated techniques that provide greater ROM than modified PNF procedures (1,8,11,18,23).

Modified PNF stretching techniques are based on PNF procedures that have been developed for various neuromuscular problems (8). Modified PNF has been reported to provide a greater increase in ROM than conventional stretching techniques (static, passive, and ballistic stretching) because of particular soft tissue lengthening and muscle contraction combinations (8,9,11,12,18,23). These stretching procedures alternate muscular contractions and soft tissue stretching in order to invoke the inverse myotatic reflex through stimulating the Golgi tendon organs (1,8,18,22). Improved ROM can be obtained in both a single stretch (acute) and in daily training environments. Slow-reversal-hold-relax is an example of such a modified PNF technique and will improve ROM in physically active individuals (1,8,11).

The effectiveness of warming up prior to stretching for improving ROM remains questionable, particularly with respect to modified PNF. One training study found that improved flexibility resulted from static stretching with or without a preliminary warm-up (26). Furthermore, several clinical studies that examined a single stretch (acute) in connection with modified PNF techniques, found that a significant increase in ROM was possible without a preliminary warm-up (6-9). Our investigation revealed that neither passive nor active warm-ups, when incorporated before PNF stretching, resulted in significant changes in ROM when compared to PNF without the use of a warm-up. It is likely that both the passive and active warm-ups did not achieve a core tissue temperature sufficient to favorably effect the thermal transition of collagen in the stretched connective tissue (13,15,19).

The inverse myotatic reflex produced from a slow-reversal-hold-relax stretching technique appears sufficient to provide an increase in acute flexibility, with or without a warm-up. There are, however, considerations other than simply increasing acute ROM. For example, the relative proportion of elastic and plastic connective tissue deformation is influenced by tissue temperature. A raised tissue temperature, coupled with a stretch, will result in effective plastic tissue elongation and longer-lasting flexibility (17,19). Laboratory evidence (21) indicates that when a relaxed muscle is physically stretched, most of the resistance to stretch is derived from the...
extensive connective tissue framework and sheathing that is within and around the muscle and not from the myofibrillar elements. Connective tissue is made up of collagen, which is resistant to stretch at normal body temperatures; but, collagen is very pliable when heated to a range between 102°F to 110°F (14,19). The relative proportion of elastic and plastic connective tissue deformation can vary widely during a stretch, depending on tissue temperature and the magnitude and duration of applied force. Raising the temperature of human tissue produces many desirable effects such as an increase in extensibility of collagen tissue, a decrease in joint stiffness, the relief of muscle spasms and pain, and an increase in blood flow (14,19).

Increased ROM is believed to accompany rising tissue temperature (13,15,19). The mechanical behavior of stretched connective tissue undergoes a favorable change—allowing increased extensibility—when the tissue is within the therapeutic temperature range. Rising tissue temperature decreases connective tissue resistance to stretch and promotes soft tissue elongation (13,15). This investigation, however, indicates that effective increases in tissue length are not affected by a warm-up when a slow-reversal-hold-relax stretching technique is used. This suggests that stimulation of the Golgi tendon organs through PNF stretching techniques can have a positive influence on ROM, with or without a warm-up. The sequence of maneuvers in the slow-reversal-hold-relax stretching technique appears to provide appropriate stimulation and inhibition of particular sensory mechanisms. For example, autogenic inhibition and reciprocal inhibition used in the slow-reversal-hold-relax stretching technique assist in improving relaxation by reducing reflex contractions in the stretched muscle. Autogenic inhibition results when the stretched antagonist (hip extensors) is isometrically contracted.

The reciprocal inhibition phenomenon occurs as the agonist (hip flexors) is concentrically contracted resulting in reflex relaxation of the opposite muscle group (hip extensors). Consequently, attempting to increase tissue temperature through an active or passive warm-up appears to be unnecessary when the slow-reversal-hold-relax technique is used for improving acute ROM. The use of a program incorporating the slow-reversal-hold-relax technique without a prior warm-up would result in time saved, but may not assist in injury prevention.

Additional investigation is needed to further establish effective procedures that can be used in conjunction with stretching techniques. The hold-relax and contract-relax modified PNF stretching technique also can be used as part of a conditioning program. Investigations incorporating other heat and cold modalities that are available also can be used as part of a conditioning program. Investigations incorporating other heat and cold modalities that are available to the athletic trainer and other medical personnel could be examined in conjunction with modified PNF stretching techniques.

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The Incidence of Hyponatremia in Prolonged Exercise Activity

Brian J. Toy, MS, ATC

ABSTRACT: Hyponatremia is a medical condition characterized by decreased concentration of sodium in the blood, which may occur in participants in endurance and ultraendurance athletic events. Slower competitors and nonacclimatized individuals appear to be at greater risk of becoming hyponatremic, especially if they experience salt depletion as a result of sweating or water intoxication. Clinical signs and symptoms of hyponatremia, which can range from muscle cramps and mental confusion to convulsions and coma, may not manifest themselves until well after the end of the event. Death may occur if hyponatremia is not properly diagnosed and treated. Medical personnel treating this condition should be cautious not to confuse water intoxication with dehydration, which produces similar symptoms. To prevent hyponatremia, participants should acclimatize themselves to race conditions prior to the event. In addition, endurance athletes should be encouraged to ingest low sodium concentrate drinks during events lasting longer than 4 hours.

Although many researchers believe that dehydration and hyperthermia are the most common reasons for collapse during endurance activities (10,11,14,28), some refute these claims (19,22,24). Exercise-induced hyponatremia, a rare problem in sports before the era of ultraendurance events (28), has been proposed as an undetected complication of such activities (9,10,20-24,27). Hyponatremia has been reported to be the predominant electrolyte disturbance incurred by participants in the Hawaiian Ironman Triathlon (11).

A variety of medical personnel, including athletic trainers, often are involved in the medical coverage of endurance events (1,25). Thus, an understanding of hyponatremia is essential to these health care providers. Although athletic trainers may have the knowledge to provide emergency first aid for the treatment of many conditions, some may not readily recognize the signs and symptoms of exercise-induced hyponatremia. Therefore, the purpose of this review is to inform the athletic trainer of the causes, symptoms, prevention, and treatment for the hyponatremic athlete.

Definition

Defined as a decreased concentration of sodium in the blood (29), hyponatremia refers to the concentration of sodium in the blood plasma and carries no connotation regarding the absolute quantity of total body sodium (15). Because normal blood sodium values range from 135 to 155 milliequivalents per liter (mEq/L) (11), an individual is considered hyponatremic when his or her serum sodium value is less than 135 mEq/L (10).

Potential Etiologies

Hyponatremia occurs when salt is lost from the body in a greater relative amount than water or when water is retained in a greater relative amount than salt (23). It can occur chronically or acutely (16) and has been reported to occur as a result of: (1) diuretic-induced potassium depletion (15); (2) renal dysfunction that results in an inability to excrete enough water to maintain body isotonicity (16); (3) sodium depletion from massive sweating (11,12); and (4) water intoxication induced by the ingestion of copious amounts of hypotonic fluid over relatively short periods of time (9,18,22,23).

Sodium Depletion

Although exercise-induced hyponatremia may result from large sodium chloride losses through sweating (11,12), the sweat of heat-acclimatized distance athletes has a low sodium chloride content (5,6). Therefore, sodium chloride losses during prolonged exercise in heat-acclimatized individuals is believed to be minor (5,6,28). For these reasons, authorities have advised that hypotonic solutions with little or no sodium chloride be ingested prior to and during prolonged exercise (2,4). However, some believe that the practice of ingesting excessive low sodium fluid during prolonged activity may lead to hyponatremia resulting from water intoxication (9,20,22-24).

Water Intoxication

In athletic participation, the etiology of hyponatremia from water intoxication appears to be voluntary hyperhydration with hypotonic solutions, combined with moderate sodium chloride losses through sweating during activity (9,22-24). One runner reportedly became hyponatremic following the completion of a marathon that took the individual 5 1/2 hours to complete (18). Hiller (10) reports that hyponatremia is common in endurance events lasting longer than 8 hours. Many researchers believe that hyponatremia most commonly occurs in ultraendurance athletes who participate in competitions that last longer than 4 hours (9,12,20,22,23).

Because slower competitors are active longer, they tend to drink excessive amounts of fluid during competition. These individuals may be at a greater risk of becoming water intoxicated than their faster counterparts (18,19,23). Furthermore, slower individuals produce less heat during exercise; therefore, they tend to sweat less and are likely to retain much of the fluid that they ingest (23). Because less nausea is experienced by slower competitors, gastric emptying is not inhibited; thus, these individuals have a greater chance of absorbing the fluid that they have ingested (23). Because some women run slower and take in more fluid during the course of a race, they may be at a greater risk of

Brian Toy is a doctoral candidate in the Department of Health Promotion and Human Performance at The University of Toledo in Toledo, OH.
Exercise-induced Hyponatremia

The most likely cause of exercise-induced hyponatremia appears to be a combination of moderately salt loss through sweat with the ingestion of large volumes of hypotonic fluids prior to and during exercise (9,22,23). Hyponatremia has been reported to occur in as many as 30% of ultraendurance event participants (13,24,26,28). Medical personnel at these events should realize that as many as 10% or more of the participants may become hyponatremic by the end of the competition (24).

Health care providers for ultraendurance events may not associate this condition with exercise because the incidence of symptomatic hyponatremia in athletes seems to be low (9,13,24). Therefore, medical personnel must realize that the clinical and laboratory signs and symptoms associated with hyponatremia will not be demonstrated by all affected athletes. In addition, the hyponatremia may not be manifested until after completion of the endurance event (9,18,23,24). This postexercise onset of symptoms is most likely caused by accelerated gastric emptying immediately following the activity (9,18). Accelerated emptying leads to an increase in absorption of fluids ingested during exercise, thus further diluting the plasma sodium content of the blood (9).

Signs and Symptoms

Clinical signs and symptoms of exercise-induced hyponatremia usually do not occur until the blood sodium level falls below 120 mEq/L (9). Symptoms include disorientation, confusion, restlessness, slurred speech (9), heat cramps (10), muscle twitching, muscle fasciculations (20), respiratory distress syndrome, respiratory arrest (24), pulmonary edema (18), nausea, stupor, convulsions, and coma (17). Grand mal seizures also have been reported (17,23,24). Untreated hyponatremia may result in brain damage or death (3,17). If water intoxication is the cause of the hyponatremia, the body may retain much of the ingested fluid. Therefore, increased body weight may be experienced by the athlete immediately following the activity and for a period of time after the event (23). In order to rid the body of excess accumulated fluid, urine output may increase for 48 hours after the termination of the activity (23).

Treatment

Dehydration is often considered the most common medical emergency incurred by athletes competing in endurance events (8,10,11,14); therefore, it has been an accepted medical practice to treat athletes who cross the finish line in an exhausted state with hypotonic intravenous (IV) solutions (8,11,22). Most researchers suggest treatment with a 5% glucose in normal saline solution following exercise that extends beyond 4 hours (11,12,28). Subsequently, some feel that athletes who suffer from water intoxication are being improperly diagnosed and treated for dehydration (20,22). One study showed that administering 1 to 2 L of a 5% glucose in 9% saline solution intravenously to collapsed athletes caused unnecessary increases in plasma volume. In most cases, researchers discovered that increases in plasma volume caused serum sodium concentrations to fall below 135 mEq/L. The author concluded that intravenous fluid therapy was not a justified treatment for all athletes who appear to be dehydrated following ultraendurance competition (22).

Clinical signs and symptoms of dehydration and hyponatremia are similar; therefore, race directors and medical personnel should be cautious when deciding if a collapsed athlete should receive hypotonic intravenous fluids. One researcher reported that physicians experienced in assessing and managing collapsed runners had trouble differentiating (on clinical grounds) between runners who had symptomatic hyponatremia and those who were dehydrated (22). Therefore, it has been suggested that, prior to prescribing IV fluid therapy for athletes considered to be dehydrated, biochemical evidence, including serum osmolality, should be obtained by the attending physician (19,22). Thus, for events lasting longer than 8 hours, medical personnel should have the capability to do on-site sodium analyses (28).

Although the occurrence of exercise-induced hyponatremia has increased since the advent of ultraendurance events, many still contend that the use of intravenous fluids is warranted in most cases of distress caused by participation in endurance events (8,11,12,22). Hyponatremia has been known to occur in conjunction with dehydration in ultraendurance athletes (11,12). Approximately 70% of the athletes treated for laboratory-diagnosed hyponatremia at the Hawaiian Ironman Triathlon were dehydrated also (10). Excessive perspiration with high sodium loss and a lack of fluid intake account for these conditions occurring together (11).

Prevention

Although some think that the ingestion of copious amounts of hypotonic fluids during endurance events may lead to water intoxication and hyponatremia (8,9,19,23,24), many researchers agree that discouraging fluid intake during endurance activities is dangerous for most athletes (8,10,11,12). Therefore, it is recommended that slower ultraendurance athletes restrict their hypotonic fluid intake (19), and that all ultraendurance athletes be encouraged to develop, train, and race with a palatable salt replacement plan (12,28). Some researchers suggest a fluid intake of no more than 500 ml per hour (22), which should include drinking fluids with a low sodium content (24). Ross (28) suggests ingesting an electrolyte solution containing 10 mEq of sodium, 10 mEq of chloride, and 5 mEq of potassium per quart of water for events that last longer than 6 hours. Unfortunately, recommendations on the amount of fluid to be ingested per hour were not given. One to two grams of sodium ingested per hour for events lasting longer than 4 hours also has been recommended (11). It has been reported that the incidence of hyponatremia in Hawaiian Ironman Triathlon participants has diminished markedly since 1983, when the practice of administering salt-containing solutions to participants was initiated (7).

In order to help an athlete prevent the onset of hyponatremia during prolonged exercise, the body should be acclimatized to competition conditions. A heat-trained athlete loses much less sodium per liter of sweat than a person who is not heat trained (5,28). Therefore, an acclimatized athlete is less likely to have low plasma sodium and will be able to ingest fluids more freely with less concern about becoming water intoxicated. This ability to ingest increased amounts of fluids also may help prevent an athlete from becoming dehydrated. Although acclimatized athletes lose less sodium in their sweat, they sweat more and have lower sweating thresholds than their nonacclimatized rivals. Thus, acclimatized individuals usually require more water during prolonged exercise (10). The acclimatization process may take 1 to 2 weeks to complete, according to one researcher (10). Others suggest that, in order to become properly heat trained, an athlete
needs to exercise 90 minutes daily in the sun at a temperature of 90° F for 10 to 14 consecutive days (28).

Although it may be overlooked as a cause of an exercise-induced medical emergency, the incidence of hyponatremia, whether it is caused by increased sodium losses or water intoxication, is well documented in the literature. All medical personnel who are responsible for caring for patients who perform these types of activities should be aware of the potential incidence of hyponatremia, the incidence of hyponatremia, and treatment of this condition. Further investigation of the possible incidence of hyponatremia in other athletic settings, such as pre-season football camp during the hot weather months, needs to be conducted.

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ABSTRACT: This study established the cumulative incidence per season of ball carrier spearing and concurrent defensive spearing by tacklers on a New Jersey high school football team. Spearing, which involves flexing the neck and initiating contact with the top of the helmet, is a significant cause of injury to the head and neck of a football player. To reduce the risk of head and neck injuries in football, all avenues of spearing must be explored. Nine game films from the 1989 football season were reviewed to determine the incidence of ball carrier spearing and concurrent defensive spearing. There were 167 incidents of ball carrier spearing (1 per 5.1 plays) and 72 incidents of concurrent defensive spearing (1 per 2.3 ball carrier spears), although no spearing penalties were called. This study detected a surprisingly high cumulative incidence of ball carrier spearing and concurrent defensive spearing, along with poor enforcement of the rule banning spearing.

In 1976, the National Collegiate Athletic Association (NCAA) and the National Federation of State High School Associations (NFHSFA) changed their football rules, making the deliberate use of the helmet to ram or punish (spear) an opponent illegal (9). The NCAA and the NFHSFA did this in an effort to reduce the incidence of head and cervical spine injuries occurring in the sport. Head and neck injuries in college and high school football have declined since 1976 (7,8,13,15), apparently because of the rule change (7,15) and subsequent changes in the way coaches teach their players to tackle (7,8,14).

Injuries to defensive backs and linebackers account for the largest percentage of cervical spine injuries (8,15). Tackling techniques of these players have received the majority of attention and corrective coaching. Consequently, officials and coaches have overlooked ball carrier spearing (Fig 1, Fig 2).

This omission of instructional technique, the lack of recognition of ball carrier spearing as a rule infraction, and poor enforcement of the spearing rule during tackling have allowed ball carrier spearing to become an accepted aspect of football. The primary focus of this study was to determine the cumulative incidence per season of ball carrier spearing and concurrent defensive spearing in high school football.

Methods

For the purpose of this study, spearing was defined as the lowering of the head, either on purpose or as a reflex action, during the tackling process. A ball carrier was defined as any player who runs with the football—running back, receiver, kick-returner, any player who returns an interception, or any player who advances a fumble. Ball carrier spearing refers to spearing by the ball carrier while being tackled. Concurrent defensive spearing was defined as a head-first technique used by the tackler of a spearing ball carrier (Fig 4).

Incidents of ball carrier spearing were tabulated if the ball carrier lowered his head before contact and initiated or attempted to initiate contact with the tackler using the top or crown portion of his helmet. I tabulated incidents of concurrent defensive spearing if the ball carrier speared on the particular play and his tackler lowered his head before contact and initiated contact using the top or crown portion of his helmet.

I only counted ball carrier spearing if the carrier speared while being tackled. Incidents of spearing by any offensive player other than the ball carrier were excluded.

Concurrent defensive spearing was counted only if a tackler used a head-first technique while tackling a spearing ball carrier. In other words, concurrent defensive spearing only occurred simultaneously...
with ball carrier spearings as defined for this study. Therefore, incidents of concurrent defensive spearings were considered only after ball carrier spearings had been established. This study excluded all other types of defensive spearings.

Data were obtained from the observation of a New Jersey high school varsity football team. I reviewed nine regular season game films from the 1989 season on a 16 mm Kodak projector that has standard reverse mode and slow motion capabilities. Each game was graded individually on its own score sheet. The score sheet consisted of: total plays, ungradable plays, ball carrier spearings, and concurrent defensive spearings—for both teams.

In viewing the game films, plays in which a ball was carried were counted in the total plays. These included: returned kick-offs, returned punts, interceptions, plays with a fumble, running plays, passes, and plays that included a penalty that allowed the play to continue, such as clipping or holding. A play was considered ungradable when contact by the ball carrier and the tackler(s) could not be seen on the game film.

Results

The totals for the nine observed games are shown in the table. There were an average of 94.9 (±8.7) total plays per game; 97% were gradable. The mean score for incidents of ball carrier spearings was 18.6 (SD 3.0) per game. The mean score for incidents of concurrent defensive spearings per game was 9 (SD 2.3).

There was an incident of ball carrier spearings in 19% of the total plays. In 43% of the plays that involved ball carrier spearings, there was also an incident of concurrent defensive spearings. The cumulative incidence per season of ball carrier spearings was 1 per 5.1 plays. The cumulative incidence per season of concurrent defensive spearings was 1 per 2.3 ball carrier spearings. The incidence of ball carrier spearings and concurrent defensive spearings per game are also shown in the table.

Discussion

Ball Carrier Spearings

Ball carrier spearings are dangerous for two reasons. First, spearings and the use of the head as an offensive weapon have an inherent risk of quadriplegia (17). Second, forces generated through running followed by head-first contact are sufficient to cause a concussion (2). Ball carrier spearings have been an overlooked hazard of being a ball carrier.

Only in three games were there less than seven ball carrier spearings for a team. Two factors that possibly could have caused a lower number of ball carrier spearings were poor performance by the offense and a high number of passing attempts.

If the offense was not "moving the ball" and making first downs (a poor performance), there would be fewer plays involving a ball carrier for that game. This could result in a lower incidence of ball carrier spearings, because the opportunities to spear were decreased.

A high number of passing attempts also could have lowered the incidence of ball carrier spearings. When an incomplete pass was thrown, there was no ball carrier as defined in this study. Also, when a receiver caught a pass, he often was tackled immediately and from behind. Both of these situations would have eliminated the possibility for ball carrier spearings.

Concurrent Defensive Spearings

The data indicated that for every two incidents of ball carrier spearings there was one incident of concurrent defensive spearings. The cumulative incidence per game of concurrent defensive spearings was consistent. A possible explanation for this may be that, generally, the defense reacts to the offense (2), and the tackler reacts to the ball carrier when attempting to make a tackle. Often what the ball carrier does will determine how the tackler brings him down (arm tackle, shirt tackle, etc.). The situation for concurrent defensive spearings arises when a ball carrier decides to break a tackle or to run over a tackler.

When a tackler has a ball carrier with his head down running directly toward him, he basically has three options. He can remain upright and attempt to make the tackle with a helmet in his chest or abdomen (Fig 3). He can attempt to get lower than the ball carrier and consequently lower his head into the spearing position (Fig 4). Or, he can choose to take on the ball carrier in a similar position, often initiating helmet-to-helmet or shoulder pad-to-helmet contact. In this study, tacklers chose the latter two options 43% of the time.

I believe that there is a relationship between incidents of ball carrier spearings and concurrent defensive spearings, although it cannot be substantiated by this study. Further research needs to be done comparing the incidence of general defensive spearings to the incidence of concurrent defensive spearings.

Reducing the Risk of Head and Neck Injuries

Spearing greatly increases the risk of head and neck injuries to defensive players while tackling (1,3,7,8,11,17). But, for some reason, this has not been applied to spearings by ball carriers. The literature mentions the danger of spearings in relation to tacklers and blockers, but neglects ball carriers. Each time a ball carrier lowers his head at contact, he increases the risk of head and neck injury. Head and neck injuries are far more common to defensive players, but this does not mean that ball carriers are immune from these injuries.

The number of total plays (TP), ungradable plays (UP), ball carrier spearings (BCS), concurrent defensive spearings (CDS) and the incidence of ball-carrier spearings and concurrent defensive spearings per game

<table>
<thead>
<tr>
<th>Game</th>
<th>TP</th>
<th>UP</th>
<th>BCS</th>
<th>CDS</th>
<th>BCS/UP</th>
<th>BCS/TP</th>
<th>CDS/TP</th>
<th>BCS/CDS</th>
<th>CDS/UP</th>
<th>CDS/TP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>88</td>
<td>1</td>
<td>20</td>
<td>7</td>
<td>1/4.4</td>
<td>1/4.0</td>
<td>1/5.7</td>
<td>1/5.4</td>
<td>1/5.6</td>
<td>1/5.8</td>
</tr>
<tr>
<td>2</td>
<td>87</td>
<td>6</td>
<td>22</td>
<td>11</td>
<td>1/5.7</td>
<td>1/4.0</td>
<td>1/5.4</td>
<td>1/5.6</td>
<td>1/5.6</td>
<td>1/5.6</td>
</tr>
<tr>
<td>3</td>
<td>102</td>
<td>1</td>
<td>18</td>
<td>8</td>
<td>1/5.4</td>
<td>1/4.0</td>
<td>1/5.4</td>
<td>1/5.6</td>
<td>1/5.6</td>
<td>1/5.6</td>
</tr>
<tr>
<td>4</td>
<td>107</td>
<td>4</td>
<td>20</td>
<td>7</td>
<td>1/5.6</td>
<td>1/4.0</td>
<td>1/5.4</td>
<td>1/5.6</td>
<td>1/5.6</td>
<td>1/5.6</td>
</tr>
<tr>
<td>5</td>
<td>101</td>
<td>3</td>
<td>18</td>
<td>10</td>
<td>1/5.6</td>
<td>1/4.0</td>
<td>1/5.4</td>
<td>1/5.6</td>
<td>1/5.6</td>
<td>1/5.6</td>
</tr>
<tr>
<td>6</td>
<td>105</td>
<td>2</td>
<td>22</td>
<td>8</td>
<td>1/5.6</td>
<td>1/4.0</td>
<td>1/5.4</td>
<td>1/5.6</td>
<td>1/5.6</td>
<td>1/5.6</td>
</tr>
<tr>
<td>7</td>
<td>89</td>
<td>1</td>
<td>13</td>
<td>5</td>
<td>1/5.6</td>
<td>1/4.0</td>
<td>1/5.4</td>
<td>1/5.6</td>
<td>1/5.6</td>
<td>1/5.6</td>
</tr>
<tr>
<td>8</td>
<td>90</td>
<td>4</td>
<td>15</td>
<td>5</td>
<td>1/5.6</td>
<td>1/4.0</td>
<td>1/5.4</td>
<td>1/5.6</td>
<td>1/5.6</td>
<td>1/5.6</td>
</tr>
<tr>
<td>9</td>
<td>85</td>
<td>5</td>
<td>19</td>
<td>11</td>
<td>1/5.6</td>
<td>1/4.0</td>
<td>1/5.4</td>
<td>1/5.6</td>
<td>1/5.6</td>
<td>1/5.6</td>
</tr>
<tr>
<td>Total</td>
<td>854</td>
<td>27</td>
<td>167</td>
<td>72</td>
<td>1/5.6</td>
<td>1/4.0</td>
<td>1/5.4</td>
<td>1/5.6</td>
<td>1/5.6</td>
<td>1/5.6</td>
</tr>
</tbody>
</table>
Mueller and Blyth (7) found that being tackled is one of the most common activities responsible for head and neck fatalities. Also, between 1977 and 1987, being tackled was the activity associated with seven cases of quadriplegia (8). The exact mechanisms for these injuries were not reported. Although we cannot conclude that spearing caused the above injuries, this study does demonstrate the possibility of such.

Buckley (2) found that wide receivers and quarterbacks had a greater risk of receiving a concussion when being tackled than when blocking. Being tackled and blocking were found to be equal risk activities for running backs. Head-to-head and head-to-knee contact with tacklers was postulated as a cause of concussions for running backs.

The head-first technique has been shown to cause cervical spine injuries in tacklers (12-15). It seems that it would be potentially dangerous to all players who spear. Albright et al (1) partially attributed the decrease in non-fatal head and neck injuries in his 8-year study to the teaching of blocking and tackling techniques that avoid the use of the head as a major weapon. Prevention of injury starts with decreasing the use of the head as a weapon (17). This information is also applicable to ball carriers.

Officials are now able to penalize any player who uses his head as a primary point of contact (5). However, the officials in this study did not exercise that power because there was not one spearing penalty called throughout the 1989 season. There were a total of 239 incidents of spearing that I observed. Missing the 167 incidents of ball carrier spearing would be expected, as ball carrier spearing is not widely recognized as a rule infraction. However, there were also 72 incidents of defensive spearing that were not called. The officials of these games were not using the spearing flag as a deterrent to players.

My observation is that the spearing flag is thrown primarily in the pile-on situation—that is, a defender coming late and head-first into a pile of players who are already down. Officials need to begin to acknowledge spearing in the tackling process to further reduce the risk of head and neck injuries. The spearing rule is stated in a way that includes all players (tacklers, blockers, ball carriers) and needs to be interpreted as such. Officials need to enforce existing spearing rules, and they should be educated about the mechanisms of serious head and neck injuries that occur to football players (3). “Referees and umpires of games who are not calling the rules as they are written should be held responsible for injuries and deaths,” according to Dr. Robert C. Cantu, Chief of Neurosurgery at Emerson Hospital in Concord, Mass (10).

**Safest Position at Contact**

According to Hodgson and Thomas (4), making contact with the head up greatly reduces the risk of serious head and neck injury. With the head up, the tackler or ball carrier can see when and how impact is about to occur and can prepare the neck musculature for impact (Fig 5). When the neck is extended, the force is absorbed by the neck musculature, the intervertebral discs, and the cervical facet joints. Both are important factors in reducing the risk of head and neck injury. Leidholt (6) emphasized the importance of ball carriers and tacklers keeping their necks in extension at contact.

This does not mean that contact should be initiated with the head, even if the neck is extended. Contact should be initiated with the shoulder while keeping the neck...
Quality

Fosfree® Prevents leg and major muscle cramping
Slo-Salt®-K Maintains hot weather performance levels
Thera-gesic® Relieves sore muscles
Supac® Rapid pain relief for the athlete with a playable injury
S.T.A. Extra tacky tape adherent
Equilet® Superior antacid
Compete® The multivitamin designed with the athlete in mind
Super Quin-9 Disinfectant for mats, tables, hands - contains nonoxynol-9 (effective against H.I.V.)
Super Cleaner Concentrated all-purpose cleaner for whirlpools, ceramic tile, etc.
Chlorastat® Non-iodine wound cleanser, antiviral, antifungal, antibacterial
Ultrasound Gel Superior conductivity in an aqueous gel

Continuing a tradition of providing only the highest quality performance products.
Leidholt (6) believe that proper coaching and the athletic trainer also should document each risk of injury. The coaching staff or the athletic trainer should demonstrate, practice proper tackling, and instruct the players, in a classroom, on techniques throughout the season. They should have the athletes sign attendance sheets at each meeting.

**Program Recommendations**

Part of an athletic trainer’s job is to inform the coaching staff of relevant injury information. The athletic trainer also should advise the coaching staff about ways to implement this information into their football program. Following are some specific recommendations aimed at reducing the risk of head and neck injuries.

The athletes should be educated about the mechanisms of head and cervical spine injuries. The athletic trainer is in the ideal position to accomplish this, by possessing the knowledge and having access to the players. The athletic trainer should instruct the players, in a classroom, on how spearing may result in head and/or neck injuries and how they can reduce the risks of these injuries. The athletic trainer should do this before contact begins, repeat it halfway through the season, and have the athletes sign attendance sheets at each meeting.

The coaching staff must teach, demonstrate, and practice proper tackling, blocking, and ball carrier contact techniques throughout the season. They should cover each technique at least three times a season: before contact begins, at game 3, and at game 6. The coaching staff or the athletic trainer also should document each time this topic is covered. Virgin (16) and Leidholt (6) believe that proper coaching staffs are teaching the correct technique and spending adequate time practicing this technique with ball carriers as well as blockers and tacklers. Unfortunately, coaches are not always willing to cooperate. If this is the case, and your personal attempts with the coach have failed, then you should approach the administration with your concerns in writing. Begin with your athletic director. Mention the spearing rules, pertinent research, the chance of liability, and who would be involved in a lawsuit. Continue up the hierarchy until you achieve the necessary results, and maintain a copy of each letter for your records.

**Acknowledgements**

I thank and credit Toby Barbosa, MEd, ATC, for placing the idea of offensive spearing in my head about 5 years ago. Also, thanks to the Millville football program for allowing me to use their equipment.

**References**

Survey of High School Football Team Strength and Conditioning Programs

Leonard V. Finamore, Jr., MA, LATC, CSCS, REMT

ABSTRACT: This study examined the level of preseason conditioning and health maintenance for high school football players in Massachusetts. In July 1988, data were obtained through a survey of high school football coaches regarding players' conditioning programs and injury rates. A total of 286 surveys were distributed to public, private, and parochial schools that have interscholastic football programs. Of these, 182 correctly completed surveys were collected for a 64% return rate. Although many high schools offer a strength training program (88%), very few of the programs have high participation levels. Only two out of five programs had more than 60% player participation. Most high schools used free weights, and many included the use of machines for their conditioning programs. Although one purpose of preseason conditioning is injury prevention, many respondents reported preseason conditioning-related injuries—47% of which involved the low back area. While static stretching techniques were typically used, over 90% of the responding coaches said the stretched position was held no longer than 10 to 20 seconds. Based upon survey results, 10 guidelines were recommended for safe, effective, and efficient conditioning programs. These include recommendations for mandatory preseason conditioning under the direct supervision of trained strength coaches, with careful attention to proper lifting technique and progression.

American high school football is a great game filled with thrills and excitement. Many suggest that it may build character and strength. Unfortunately, there is a dark side to this popular game—a high injury rate (2,4,9,13,17,18,20,24).

Each year, 3 to 5 million sports injuries are seen at emergency rooms across the country. Football is responsible for many of these injuries to boys (20). In 1989, one in fourteen teenage athletes in Massachusetts required hospital treatment, with the largest percentage being football participants (9). It is estimated that 49,000 of these young athletes are injured each year (20).

A staggering amount of money is spent every year on football injuries (16,18,22). For example, in 1985 the total football injury cost at one high school in Minnesota was $6755.00. The average cost per injury was $211.09, and the average cost per player was $187.63 (22).

Many injuries can be prevented by implementing a strength and conditioning program (2,7,10,12,23,26,29). Wilkerson (27) has discussed some of the practical implications of stretching, which apply to developing flexibility in young athletes. According to one youth fitness study, one-third of America's youth are not active enough to achieve aerobic or cardiovascular fitness (i.e., lowered heart rate, more efficient coronary and peripheral circulation, stabilized or decreased blood pressure, and a generally improved cardiovascular-respiratory system). To compound this problem, many unfit youths play for coaches who are inexperienced in preparing student athletes for competitive performance (20). The purpose of this study was to determine how Massachusetts high schools are dealing with injury prevention through their strength and conditioning programs.

Methods

We developed a survey to analyze the current methods used by high schools in Massachusetts to deal with injury prevention. The survey included 35 specific questions regarding the preventive conditioning practices of high school football teams. This article presents responses to several of these questions and makes recommendations for reducing the risk of injury of high school football players.

The questionnaire included both open-ended and closed questions to determine: (1) information about the personnel involved in the development and supervision of the program; (2) information about the typical strength and conditioning programs; and (3) information, if any, about specific injury prevention exercises and/or awareness.

We distributed a total of 286 surveys to the public, parochial, and private schools that offer interscholastic football in Massachusetts. The survey questionnaire was addressed to every high school head football coach in Massachusetts. A cover letter explained the purpose of the study.

After reviewing the returned questionnaires for completeness, each question of the survey was analyzed and the responses were converted to percentages.

Survey Results

Of the 286 surveys distributed, 182 (64%) correctly completed surveys were returned. All five divisions across the state were adequately represented in the results. The most significant findings were as follows:

Supervision

Most of the existing programs (69%) were supervised by the head football coach (Table 1). Perhaps the most interesting finding was that 25% of the programs were supervised by a teacher or a former/present player. Attendance was taken in 50% of the programs.

Injury Prevention

Thirty-seven percent of the respondents listed injury prevention as one of the basic goals/objectives in their strength program. Most of the respondents (71%) said that their programs included specific injury prevention exercises, but only 6% said that they use testing to identify potential injuries.

The most commonly injured area was the ankle/foot (38%), followed by the knee (27%). The body area most emphasized

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Len Finamore is head athletic trainer/educator at Catholic Memorial High School in West Roxbury, MA.
during injury prevention education was the neck (40%), followed by the knee (30%) (Table).

**Best Single Indicator of Football Playing Ability**

Some form of muscular conditioning (24%) was listed by the respondents as the best single indicator of ability in playing football (Table).

**Strength Training Exercises/Injuries**

Free weights (53%) were the exercise modalities most used. Twenty-seven percent said that they preferred isotonic variable resistance or weight machines.

The most popular core (or main) exercises used in the programs were the bench press (29%) and squat lift (24%). Other frequently used exercises were the power clean, military press, and deadlift. The low back was the area of the body reported to suffer strength training injuries most often (Table).

**Warm-Up/Muscle Soreness/Flexibility**

The majority (91%) of the programs used some type of warm-up. Many programs (79%) reported muscle soreness as a result of strength training. Respondents reported using some type of flexibility technique. The techniques most widely used by schools were the static method (65%) and the Proprioceptive Neuromuscular Facilitation (PNF) method (28%). Seven percent of the respondents used the ballistic method.

**Discussion**

Although many high schools offer strength training programs, several aspects of their preseason conditioning programs could be improved. There is a strong correlation between preseason conditioning and the prevention of football injuries (2,7,10,12,19,23,26,29). Therefore, it makes sense to have mandatory strength and conditioning training for high school football players. Unfortunately, the Massachusetts Interscholastic Athletic Association (MIAA) rules that coaches cannot mandate such training; therefore, any athlete, regardless of his or her conditioning level, is allowed to participate in football.

Although many of the existing strength training programs are supervised by a qualified adult (ie, football coach, athletic trainer, strength coach), the lack of adult supervision in some programs is unacceptable. Quality leadership, through the promotion of safety and motivation, is the key to a successful program. Good supervision facilitates proper technique, which may reduce weight training injuries and prevent overtraining. To ensure that the adolescent athlete engages in proper strength training, each session should be adequately supervised and attendance should be recorded.

When designing the program, one of the areas that must be addressed is the sport's most frequent anatomical injury sites. Making the athlete stronger and safer in his or her environment is an important goal (29). Excluding the wrist and hand, the most common site of injury is a lower extremity. When the hip/lower back is added to the lower extremities, they account for most of the injuries in football.

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**Table: Goals and Objectives in Testing Football Athletes**

<table>
<thead>
<tr>
<th>Question</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who Develops and Supervises the Strength and Conditioning Program?</td>
<td>Football Coach 126 69%</td>
</tr>
<tr>
<td></td>
<td>Athletic Trainer 4 2%</td>
</tr>
<tr>
<td></td>
<td>Strength Coach 7 4%</td>
</tr>
<tr>
<td></td>
<td>Former Player 11 6%</td>
</tr>
<tr>
<td></td>
<td>Present Player 16 9%</td>
</tr>
<tr>
<td></td>
<td>Teacher 9 5%</td>
</tr>
<tr>
<td></td>
<td>Parent/Other 9 5%</td>
</tr>
</tbody>
</table>

**Table: Goals and Objectives in Testing Football Athletes**

<table>
<thead>
<tr>
<th>Question</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goals and Objectives in Testing Football Athletes</td>
<td>To determine strengths and weaknesses 42 23%</td>
</tr>
<tr>
<td></td>
<td>To set goals 37 20%</td>
</tr>
<tr>
<td></td>
<td>To identify potential injuries 11 6%</td>
</tr>
<tr>
<td></td>
<td>To motivate 47 25%</td>
</tr>
<tr>
<td></td>
<td>To profile each athlete 25 14%</td>
</tr>
<tr>
<td></td>
<td>To evaluate the effectiveness of your program 20 11%</td>
</tr>
</tbody>
</table>

**Table: Basic Goals and Objectives of the Strength Program**

<table>
<thead>
<tr>
<th>Question</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best Single Indicator of Football Playing Ability</td>
<td>Muscular Strength 15 8%</td>
</tr>
<tr>
<td></td>
<td>Muscular Endurance 15 8%</td>
</tr>
<tr>
<td></td>
<td>Muscular Power 15 8%</td>
</tr>
<tr>
<td></td>
<td>Flexibility 16 9%</td>
</tr>
<tr>
<td></td>
<td>Cardiovascular Endurance 11 6%</td>
</tr>
<tr>
<td></td>
<td>Agility 31 17%</td>
</tr>
<tr>
<td></td>
<td>Speed 33 18%</td>
</tr>
<tr>
<td></td>
<td>Body Composition 1 3%</td>
</tr>
<tr>
<td></td>
<td>All of the above 45 25%</td>
</tr>
</tbody>
</table>

**Table: Area of the Body Most Commonly Injured**

<table>
<thead>
<tr>
<th>Question</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best Single Indicator of Football Playing Ability</td>
<td>Head 1 4%</td>
</tr>
<tr>
<td></td>
<td>Hip/Lower Back 7 4%</td>
</tr>
<tr>
<td></td>
<td>Neck 7 4%</td>
</tr>
<tr>
<td></td>
<td>Thigh/Knee 49 27%</td>
</tr>
<tr>
<td></td>
<td>Shoulder/Arm 25 13%</td>
</tr>
<tr>
<td></td>
<td>Lower Leg 7 4%</td>
</tr>
<tr>
<td></td>
<td>Ankle/Foot 69 38%</td>
</tr>
<tr>
<td></td>
<td>Forearm 1 4%</td>
</tr>
<tr>
<td></td>
<td>Wrist/Hand 16 9%</td>
</tr>
</tbody>
</table>

**Table: Body Area Emphasized During Strength Program**

<table>
<thead>
<tr>
<th>Question</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Area Emphasized During Strength Program</td>
<td>Shoulder 22 12%</td>
</tr>
<tr>
<td></td>
<td>Back/Hip 20 11%</td>
</tr>
<tr>
<td></td>
<td>Knee 55 30%</td>
</tr>
<tr>
<td></td>
<td>Ankle 12 7%</td>
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<td></td>
<td>Neck 73 40%</td>
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**Table: Type of Training Modalities Preferred**

<table>
<thead>
<tr>
<th>Question</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Goals and Objectives of the Strength Program</td>
<td>To improve athletic performance 62 34%</td>
</tr>
<tr>
<td></td>
<td>To prevent injury 67 37%</td>
</tr>
<tr>
<td></td>
<td>To increase size and weight 29 16%</td>
</tr>
<tr>
<td></td>
<td>To improve mental attitude 24 13%</td>
</tr>
</tbody>
</table>

**Table: Core (or Main) Exercise(s) Used in Strength Program**

<table>
<thead>
<tr>
<th>Question</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength Training Injuries Encountered</td>
<td>Lower Back/Hip 89 49%</td>
</tr>
<tr>
<td></td>
<td>Neck 7 4%</td>
</tr>
<tr>
<td></td>
<td>Shoulder/Chest 47 26%</td>
</tr>
<tr>
<td></td>
<td>Groin 23 12%</td>
</tr>
<tr>
<td></td>
<td>Elbow 16 9%</td>
</tr>
</tbody>
</table>

**Table: Type of Training Modalities Preferred**

<table>
<thead>
<tr>
<th>Question</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Training Modalities Preferred</td>
<td>Isotonic Free Weights 96 53%</td>
</tr>
<tr>
<td></td>
<td>Isotonic Variable Resistance (Machines) 49 27%</td>
</tr>
<tr>
<td></td>
<td>Isometrics 4 2%</td>
</tr>
<tr>
<td></td>
<td>Isokinetics (Cybex, KinCom, Orthotron) 1 4%</td>
</tr>
<tr>
<td></td>
<td>Partner Resistance 11 6%</td>
</tr>
<tr>
<td></td>
<td>Gymnastic Exercises 7 4%</td>
</tr>
<tr>
<td></td>
<td>Any combination of the above 13 7%</td>
</tr>
</tbody>
</table>

**Table: Core (or Main) Exercise(s) Used in Strength Program**

<table>
<thead>
<tr>
<th>Question</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core (or Main) Exercise(s) Used in Strength Program</td>
<td>Power Clean 22 12%</td>
</tr>
<tr>
<td></td>
<td>Dead Lift 17 10%</td>
</tr>
<tr>
<td></td>
<td>Squat Lift 44 24%</td>
</tr>
<tr>
<td></td>
<td>Bench Press 53 29%</td>
</tr>
<tr>
<td></td>
<td>Military Press 22 12%</td>
</tr>
<tr>
<td></td>
<td>Calf Raise 13 7%</td>
</tr>
<tr>
<td></td>
<td>Nautilus Circuit 11 6%</td>
</tr>
</tbody>
</table>
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Head Trainer
SEATTLE SEAHAWKS

Seattle Seahawks
For this reason, it is recommended that special attention be given to the lower extremities when performing injury prevention exercises. Although many programs reported including injury prevention exercises, the neck was emphasized the most. This is probably because of the possibly fatal or extremely serious consequences of an isolated neck injury. However, because of the current care, the conditioning, and the rule changes prohibiting the use of the head when initiating contact, the neck accounts for only 4% of all injuries in football.

In contrast, the knee, where 27% of injuries occur, is emphasized in only 29% of the programs. Because the knee is so vulnerable, more emphasis should be placed on strengthening the knee joint. For example, all the muscle/tendon units that cross the knee joint should be strengthened, including the knee extensors, knee flexors, hip adductors, hip abductors, and calf muscles. Because the knee extensor muscles (quadriceps) support the weight of the entire body, they are the largest, most powerful muscles of the body (8). Therefore, emphasizing the hamstrings in strength training is suggested to offset the strength of the more powerful quadriceps.

Another often neglected area of the body is the ankle/foot. Only 7% of the teams surveyed trained this important area where 38% of the injuries in football occur.

By determining strengths and weaknesses, one can identify potential injuries and, at the same time, profile an athlete. Therefore, the testing process is actually an injury prevention tool. To be most effective, testing of high school athletes should be done at least twice a year. Ideally, three times a year is recommended—at the end of the football season, at the completion of the winter training season, and at the end of the summer before the start of the football season (1).

Because strength training affects muscular conditioning, some form of muscular ability is the single best indicator of football playing potential. Although strength training can affect other areas of physical conditioning, such as flexibility, agility, speed, etc., its effect on muscular conditioning is most significant. One of the best known benefits is hypertrophy of the muscle fiber, increasing both the size and strength of the muscle (5).

The major disadvantage of free weights is the increased chance for injury (8). The core exercises were accomplished through using free weights to perform squat lifts, bench presses, military presses, power cleans, and dead lifts. Although it was encouraging to find that some programs did not experience strength training injuries, most respondents reported low back injuries. Most low back injuries occur as a result of improper lifting technique and a lack of proper supervision (2).

Any athlete unaccustomed to strength training will experience muscle soreness, but if he or she continues to train, it should subside. Because some muscle trauma results from a strength training session, muscle soreness may occur. I recommend the following steps to reduce muscle soreness:

1. Include a warm-up before the training session.
2. Have athletes perform flexibility exercises (stretching) before and after the strength exercises.
3. Ensure that the athletes use appropriate weight loads and proper technique.

A warm-up helps ensure a safe workout, avoiding unnecessary injuries, while reducing muscle soreness. The purpose of a warm-up is to prepare the body for physical exertion by elevating the body temperature slightly and making tendons and muscles better lubricated and more elastic.

Adequate flexibility is very important to the adolescent athlete and must be accomplished through some form of stretching. To keep up with the bone elongation experienced during adolescence, one must elongate muscle fibers through progressive stretching (11).

Although many of the programs used either the static or PNF flexibility method, a few of the programs used the ballistic method. Without question, the ballistic stretching method contains risks that far outweigh its benefits. Although the PNF method may be superior to the static method, it may be difficult for the adolescent athlete to follow the correct procedures. In fact, it can actually be dangerous if the partner is not careful in his or her technique and assistance (28).

The static flexibility method is very effective and can be accomplished without a partner. It consists of a slow, steady stretch to the point of tightness, or when the tissues can no longer be stretched. Furthermore, it is recommended that this position be held for at least thirty seconds to achieve maximum benefits (5). When the static method was used, over 90% of the responding coaches said that the position was held for 10 to 20 seconds. Although this type of stretch is better than not stretching at all, the fully stretched position should be held longer to elicit maximum flexibility gains (3).

Conclusions

Injury Prevention Exercises

The coach should include specific injury prevention exercises for each body area, such as the following:

1. Total body—squat lift, bench press, dead lift
2. Neck—four-way neck machine, high pulls, power cleans/snatches
3. Shoulder—upright rows, shoulder raises, lateral raises, push press/jerk
4. Back/Hip—abdominal crunches, trunk rotation
5. Knee—leg curl, hip abduction/adduction, calf raises
6. Ankle—surgical tubing stretch, plate lift, towel resistance, toe raises

Total body exercises enlist the involvement of many major muscle groups. For example, the squat lift involves the knee joint, thigh (back and front), hips, low back, and abdominals (15).

Without question, a strong neck is a must in football, because of the obvious consequences that may occur with a neck injury. But, more importantly, a strong neck may prevent the common occurrence of nerve pinch/stingers that could lead to a career-ending injury (19).

The shoulder exercises focus on the underused rotator cuff muscles, which are crucial for shoulder stability. Unfortunately, shoulder exercises too often focus on only the front deltoid muscle, while neglecting the important rotator cuff muscles (26).

Injury prevention can include protective equipment, safe playing conditions, and protective taping bandaging; but, the key to injury prevention for high school football players is the commitment to a sound, supervised, and safety-oriented strength and conditioning program. Although injuries still will occur, the frequency and severity should be reduced in well-conditioned athletes.

In summary, strength training should be safe, effective, and efficient. The following guidelines are recommended:
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1. All interscholastic football players should undergo at least several weeks of preseason conditioning.
2. Strength training sessions should be supervised by a knowledgeable coach and attendance must be recorded.
3. Whenever possible, strength training should be executed using machines and free weights.
4. Strength training should be done on a regular basis, two or three times per week.
5. At least one set of each specific injury prevention exercise should be completed every session.
6. All candidates for football should be tested three times per year (ie, off-season, preseason, and postseason).
7. A coach who is committed to a sound, safety-oriented strength training program, and who shows sincerity and concern for the athletes, may be the best motivating factor.

Acknowledgements

I appreciate Dr. Wayne Westcott for giving his unlimited time and professional expertise concerning strength training and for patiently and exhaustively reading and editing my written work. Without his guidance throughout the study, neither my thesis nor this article would have been possible.

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14. Panariello R. Beyond plyometrics: other conditioning and rehabilitation techniques for athletes. Presented at the annual meeting of Athletic Trainers of Massachusetts; June 10-11, 1988; Norton, MA.
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Conservative Management of Piriformis Syndrome

Cornelius, Hands:  
The Effects of a Warm-up on Acute Hip Joint Flexibility Using a Modified PNF Stretching Technique

Toy:  
The Incidence of Hyponatremia in Prolonged Exercise Activity

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CEU QUIZ
Journal of Athletic Training
Physical Education Department
Indiana State University
Terre Haute, IN 47809

Circle the correct answer.

1. Which of the following is not a clinical sign of hyponatremia?
   a. disorientation
   b. decreased urine output
   c. restlessness
   d. grand mal seizures
   e. respiratory distress syndrome

2. Testing for piriformis syndrome may include:
   a. superficial palpation while the athlete is in a prone position.
   b. conventional manual muscle tests for the external rotators while the athlete is sitting.
   c. range of motion tests.
   d. all of the above
   e. b and c

3. Ways of preventing hyponatremia include:
   a. acclimatizing oneself to race conditions prior to the race.
   b. ingesting high sodium concentrate drinks during events lasting longer than 4 hours.
   c. running slowly during a race and ingesting more fluids.
   d. a and b
   e. a and c

4. Which, if any, of the following statements about modified PNF stretching techniques are not true?
   a. They can be effective techniques for increasing joint range of motion.
   b. They are based upon PNF procedures developed for various neuromuscular problems.
   c. Compared to conventional stretching techniques, range of motion is not increased.
   d. They alternate muscular contrac-

5. A survey of high school football coaches in Massachusetts supports the following conclusions:
   a. There is a strong relationship between preseason conditioning and injury prevention in football.
   b. The knee is the most commonly injured area.
   c. Mandatory strength and conditioning training in high school football makes sense.
   d. Too many programs are supervised by an inexperienced person.
   e. all except b

6. Ball carrier spearing:
   a. is a cause of head and neck injuries.
   b. involves flexing the neck and initiating contact with the top of the helmet.
   c. was declared illegal in 1976 by the NCAA and the NFHS.
   d. all of the above
   e. a and b

7. When attempting to make a clinical diagnosis of piriformis syndrome:
   a. passive internal and external rotation of the hip probably will not be painful.
   b. a neurovascular assessment should be made to rule out more severe spinal pathology.
   c. consideration of the function of the piriformis at varying joint angles is unimportant.
   d. there probably will be some superficial tenderness, but deep pain will be absent.
   e. none of the above

8. Injury prevention in football should include which of the following?
   a. well-supervised, knowledgeable strength training
   b. protective taping/bandaging
   c. shoulder exercises focusing on the important underused rotator cuff muscles
   d. the static or PNF flexibility method of warming up
   e. all of the above

9. Ways to overcome ball carrier spearing are:
   a. Keep the head up and the neck in extension.
   b. Initiate contact at the shoulder.
   c. Athletic trainers should inform coaches of potential dangers of ball carrier spearing as well as defensive spearing.
   d. Athletic trainers must ensure that coaching staffs are teaching correct technique and spending adequate time practicing with ball carriers as well as with blockers and tacklers.
   e. all of the above

10. Hyponatremia occurs:
    a. when salt is lost from the body in excess of water.
    b. when water is retained in excess of salt.
    c. as a result of diuretic-induced potassium depletion.
    d. most commonly in ultraendurance athletes who participate in competitions lasting longer than four hours.
    e. all of the above

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</tr>
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</tr>
<tr>
<td>GatorPro® Nutritional Supplement</td>
<td>With meals or as a snack</td>
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</tbody>
</table>

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Abstracts of 1992 NATA National Convention Free Communications

Oral Presentations

The Effect of Ice Immersion on Joint Position Sense
LaRiviere JA, Ostermig LR. University of Oregon, Eugene, OR 57403

This study was designed to determine the effect of ice immersion on ankle joint position sense. Clinically, cold applications to a body part have been shown to be effective in reducing pain, increasing tissue density, reducing intramuscular temperature, and decreasing nerve conduction and rate of firing. While the ice-induced anaesthetic effect on the body part may allow pain free activity, it also may mask certain protective mechanisms. Therefore, icing before a skilled performance may distort the ability to acknowledge sensory stimuli. There is evidence to suggest that cold application to a body part may affect proprioception by lowering the sensitivity of the muscle spindles and perhaps by anesthetizing the skin proprioceptive receptors (Iggo, 1977). Inadequate peripheral feedback regarding position of a limb in space could expose the joint to injury. Consequently, cooling a body part prior to athletic performance may be contraindicated. Thirty-one subjects (21 females, 10 males, age = 21.4+2.1 yr) with healthy pain-free ankles were examined. Three different pretest conditions of no ice immersion, 5 minutes of ice immersion, and 20 minutes of ice immersion were administered prior to ankle joint angle replication testing. Subjects attempted to replicate two predetermined mid-range ankle positions using the Orthotron II isokinetic ankle attachment. Subjects completed eight repositioning trials (four at each test angle) following each pretest condition. A multivariate analysis of variance (MANOVA) revealed no statistically significant difference between conditions, trials, or angles. Additional analyses of variance (ANOVA) revealed no significant differences between the order of pretest conditions or gender. The fact that joint position sense showed no significant differences following ice immersion when compared to the no ice immersion pretest condition, implies that joint position sense receptors in the ankle are resilient to this type of treatment; the two ice immersion conditions did not adversely affect the receptors responsible for sensing position; or the affected receptors (ie, skin and/or muscle receptors) were adequately compensated for by other receptors, such as joint receptors. The results indicate that the ice immersion protocols administered in this study do not affect joint position sense. However, it would be imprudent to suggest that ice immersion immediately prior to athletic performance is without effects.

Effect of Cold Water Application on Isokinetic Strength of the Plantar Flexors
Mattacola CG, Perrin DH. University of Virginia, Charlottesville, VA 22901

Cold is commonly applied to athletes immediately before sports participation. The purpose of this study was to determine the effect of cold water submersion on the isokinetic strength of the plantar flexor muscle group. Eleven females and five males (means: age=22.1 yr, ht=170.8 cm, wt=64.5 kg) with no history of ankle joint pathology were tested with a Cybex II isokinetic dynamometer for peak torque, average power, and total work of the dominant foot at 60°/sec. Prior to isokinetic testing, subjects were randomly assigned to either a cold water submersion or a rest condition. Subjects returned 1 week later to receive the opposite condition and undergo another Cybex test session. The cold water submersion (CWS) consisted of placing the leg in a 15°C tub of water for 20 minutes. The rest period (RP) consisted of remaining seated for a 20-minute period. Paired t-tests were computed to determine if any differences existed in peak torque (PT), average power (AP), and total work (TW), between the CWS and RP conditions. Results indicated lower values for CWS PT (CWS PT=50.3 ft-lb, RP PT=60.5 ft-lb, p<.01), CWS AP (CWS AP=45.1 watts, RP AP=54.4 watts, p<.01) and CWS TW (CWS TW=224.7 ft-lb, RP TW=275.1 ft-lb, p<.01). These findings indicate that isokinetic torque, power, and work of the plantar flexor muscle group are reduced immediately following cold water submersion. Further research should be undertaken to determine the length of time that isokinetic strength is reduced before returning to normal after cold water submersion.

Ankle Skin Temperature Changes With a Repeated Ice Pack Application
Post JB, Knight KL. Sports Injury Research Laboratory, Indiana State University, Terre Haute, IN 47809

The effects of a second ice pack application on ankle skin temperature cooling and rewarming characteristics were examined. Four experimental conditions were applied to 15 subjects, two conditions (one to each ankle) on each of 2 days. The conditions had the following application and postapplication cycles: 20 minutes on, 60 minutes off; 20 minutes on, 90 minutes off; 30 minutes on, 60 minutes off; and 30 minutes on, 90 minutes off. Subjects were required to remain supine for the entire session. After 30 minutes of preapplication rest, ice packs were applied to both ankles and secured with elastic bandages. After 20 or 30 minutes, the ice packs were removed and the elastic bandages were reapplied for the 60- or 90-minute postapplication period. The cycle of application and postapplication was repeated. Ankle skin temperatures were measured with a YSI telethermometer every 2½ min-
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utes for the initial 15 minutes of an application or postapplication period, and every 5 minutes at all other times for the entire session. Room temperature was recorded every 5 minutes. Differences between the first and second applications and among the four conditions were evaluated with a repeated measures analysis of variance (ANOVA). Significant differences were further analyzed with one-way ANOVAs and Duncan Post Hoc tests. Skin temperature decreased immediately and rapidly with ice pack application. The 30/90 condition resulted in significantly colder temperatures after the first application than either the 20/60 or the 20/90 conditions (F(3,42)=2.67, p=.06, Duncan Post Hoc Analysis p>.05). Temperatures were significantly lower at the start of the second application than at the start of the first application (F(1,14)>11.85, p<.004). The 30/60 condition was significantly colder than the other three conditions at the end of the first rewarming (F(3,42)=5.25, p=.004, Duncan Post Hoc Analysis p<.05). The atmospheric temperature for the experiment did not deviate among the four conditions (F(3,42)=1.40, p=.24) or between the first and second applications (F(1,2398)=.74, p=.39). This study did not confirm or refute the evidence for a 30-minute instead of a 20-minute ice pack application. A second application cycle following certain time restrictions can result in decreased skin temperature. If additional reapplications have an additional cooling effect, this may result in tissue damage. More research is needed.

Ankle and Thigh Skin Surface Temperature Changes With Repeated Ice Pack Application
Palmer JE, Knight KL. Sports Injury Research Laboratory, Indiana State University, Terre Haute, IN 47809

Previous research on the temperature changes caused by cold pack applications has used protocols with subjects lying on laboratory tables throughout application and post application. In a clinical situation involving an acute injury, however, subjects typically shower following the initial cold pack application and then return home. This research integrated these activities into the protocol. Three experimental conditions (20-, 30-, and 40-minute ice pack applications and 60-minute rewarming) were applied to 12 subjects. Each subject was tested under all conditions using a balanced Latin Square design. Subjects were required to ride a bicycle ergometer for 15 minutes prior to ice pack application (20, 30, or 40 minutes) to the ankle and opposite thigh. During rewarming, subjects were moderately active for 20 minutes as they simulated showering, changing clothes, and returning home. The elastic wrap was reapplied and the limb rewarmed for another 40 minutes. Ice application and rewarming were repeated with the exclusion of the simulated activity. Ankle and thigh skin temperature and atmospheric temperature were measured every minute using Iso-Thermex (a computer data collection system) J type thermocouples. The temperature prior to ice pack application (time = 0) was different between limbs and conditions, so temperature change (from beginning to end of the time period) was used for analysis.

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to analyze all data. Temperature changes were greater in the thigh than in the ankle. In both limbs, rewarming was greater during the first rewarming session than the second, especially in the groups that had ice applied for a shorter time. Overall, application of ice packs for 40 minutes resulted in greater temperature decreases than applications for 30 and 20 minutes. Because of the extent of rewarming that occurs during and following showering, while changing clothes, and while returning home, ice packs should be reapplied immediately following these activities.

The Effects of Intermittent Compression on Edema in Postacute Ankle Sprains
Rucinski TJ, Hooker DN, Prentice WE, Shields EW, Coté-Murray DJ, Milwaukee County Medical Complex-Sports Medicine Center, Wauwatosa, WI 53213

The objective of this study was to compare the effects of three treatment protocols on pitting edema in patients with first and second degree sprained ankles. Thirty subjects with postacute (greater than 24 hours postinjury) ankle sprains and pitting edema (not requiring cast immobilization) were randomly assigned to an elastic wrap group (N=10), an intermittent compression group (N=10), or an elevated control group (N=10). Pretreatment and post-treatment volumetric measurements of the subjects’ ankles were obtained by the water displacement method. After the pretreatment measurement, the groups were treated for 30 minutes. All subjects’ ankles were elevated by raising the foot section of an adjustable table to a 45° angle during treatment. For the first group, the intermittent compression device was set at 40 to 50 mm Hg, with a 60-second “on time” and a 15-second “off time.” For the second treatment group, an elastic wrap was applied from the heads of the metatarsals to 12.7 cm above the malleoli. Control group subjects received only elevation. A 3x2 repeated measures analysis of variance (ANOVA) with a follow-up post hoc test revealed that the elevated control group had the least amount of edema (p<.0006).

The two compression protocols produced increased edema in the subjects’ sprained ankles following treatment. In conclusion, elevation is the most appropriate of the three treatment protocols if the therapeutic objective is to minimize edema in the postacute phase of rehabilitation. Researchers interested in replicating this study should note the following recommendations for changes in study design and procedure: (1) Compare the effectiveness of a sequential multicell compression device to an intermittent compression device in reducing edema. (2) Take serial measurements over a period of days to see the effect that an intermittent compression device has on edema over time. (3) Change the on/off time, pressure setting, and total treatment time. (4) Repeat the study using ice coupled with the compression treatments. (5) Repeat the study with a larger population.

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The Effects of Intermittent Compression and Cold on Reducing Edema in Postacute Ankle Sprains
Sabiston KB, Prentice WE, Hooker DH, Shields EW. North Cobb Physical Therapy and Sports Clinic/Marietta High School, Marietta, GA 30060

The objective of this study was to evaluate the effectiveness of intermittent compression, coolant, and elevation (Jobst Cryotemp) in reducing postacute ankle sprain edema. Results from this technique were compared to those from a more conventional technique of compression (elastic wrap), ice, and elevation and to results from a control group using elevation only. Thirty subjects with unilateral ankle sprains exhibiting pitting edema were alternately assigned to the three treatment groups. Volumetric water displacement measurements and three anthropometric measurements (proximal, distal, and figure-eight) were taken before and after treatments in order to measure edema. Pearson Product Moment Correlations were used to compare the volumetric measures to the figure-eight measures. The average volumetric and anthropometric change values for the three treatment groups were contrasted by a 3x2 repeated measures analysis of variance (ANOVA). Significant interaction effects were found for the volumetric measurements (p<.0001) and for the proximal anthropometric measurement (p=.0003). Tukey Honestly Significant Difference (HSD) analysis showed that the Jobst Cryotemp method significantly reduced edema as measured volumetrically and proximally with mean decreases of 13.3 ml and 0.20 cm, respectively. In addition, the Jobst Cryotemp technique was more effective in reducing postacute ankle sprain edema than the elastic wrap with ice and elevation. The volumetric and figure eight measurements were highly correlated (0.9 and 1.0) as determined by the Pearson Product Moment Correlations. The primary conclusions of this study are that the Jobst Cryotemp technique with its intermittent compression, coolant, and elevation, is highly effective in reducing edema in postacute ankle sprains and appears to be significantly more effective than the conventional treatment of elastic wrap, ice, and elevation.

A Comparison of Two Conducting Media and Their Influence on Muscle Temperature in the Human Leg During Ultrasound Treatments
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Ultrasound is one of the most widely used therapeutic modalities. This is, in part, a result of its ability to penetrate skin and fat and focus its energy on muscles, ligaments, and tendons. Because ultrasound cannot be transmitted through the air, a conducting medium is necessary to transport the energy through the tissues. The two most widely used conducting media are ultrasound gel delivered topically and immersion in tap water. The purpose of this study was to determine which conducting medium caused the greatest tissue temperature increase (TTI) in the human leg. Twenty males (mean age=23 yr) served as subjects. A 23-gauge hypodermic needle microprobe was inserted 3 cm deep into the medial portion of the anesthetized gastrocnemius muscle of each subject. The needle thermister then was connected to a monitor. Each subject participated in two random order treatments. During the gel treatment, 15ml of 37°C ultrasound gel was applied to a treatment area that was 10 cm in diameter. Continuous ultrasound was delivered topically at 1.5 watts/cm² for 10 minutes. During this time, the soundhead was moved at a speed of 4 cm per second, and the temperature was recorded every 30 seconds. After the first treatment, ice was applied to the area to assist the temperature in decreasing to the baseline level. During the water medium technique, the subject’s leg was immersed in a container of 37°C water. We attached an applicator to the soundhead to keep it the recommended distance of 1 cm from the skin during all 20 treatments. As in the first treatment, the intensity was set at 1.5 watts/cm². The soundhead was moved at the same speed over the 10 cm treatment area, and temperature was recorded every 30 seconds for 10 minutes. The baseline temperature for each medium was 35.5°C. The topical gel medium produced a temperature of 40.3°C, whereas the immersion technique produced a temperature of only 37.6°C. This resulted in a significant difference (p<.001) between the two media. Forest and Rosen (1989) determined that ultrasound that does not heat tissue to at least 40°C is ineffective. Therefore, from this study we have shown that the topical application of ultrasound gel is a superior medium when a TTI is desired in tissues that are at least 3 cm deep. In addition, we can conclude that the immersion technique is ineffective at this depth.

Effects of Stair Climbing Versus Cycling Following Postoperative Anterior Cruciate Ligament Reconstruction and Rehabilitation: A Preliminary Report
Meyers MC, Calvo RD, Marley RR, Duhon TK. Texas Sports Science Institute, Sugar Land, TX 77478

The increased use of stair-climbing devices to improve fitness has been suggested as an alternative to upright cycling for knee rehabilitation in the injured athlete. However, the magnitude of change/response in an actual postoperative sports rehabilitation population is not well known. The objective of this ongoing study was to quantify and compare lower extremity response in 27 athletes (17 males, 10 females, age 24.8±8.4 yr) following a postoperative anterior cruciate ligament (ACL) rehabilitation using cycle ergometry (C, n=13) or stair climbing (S, n=14). Following positive written informed consent, athletes were randomly assigned to either the S or C programs previously matched by metabolic equivalents (METs) and heart rate. Isokinetic testing (Kin Com) was performed at 1 week and 3 months postoperative to determine mean and peak concentric quadriceps (CQ), eccentric quadriceps (EQ), concentric hamstring (CH), and eccentric hamstring (EH) strength. Pre/post leg girths were measured (+3, +6, +9, -3, -6, -9 inches above/below the superior/inferior poles of the patella). A multivariate analysis of variance (MANOVA) indicated no significant differences (p=.05) in strength gains (N/m) between the C and S groups, respectively, in mean CQ (38.8±16.0 vs 81.1±14.1), peak CQ (40.6±21.7 vs 92.7±19.1), mean EQ (87.4±21.8 vs 60.3±19.2), peak EQ (115.2±29.3 vs 69.0±25.9), mean CH (6.6±6.8 vs 20.2±6.0), peak CH (22.2±10.6 vs 30.2±9.3), mean EH (27.3±10.0 vs 30.2±9.6) or peak EH (41.5±16.5 vs 34.7±14.6). No significant differences (p=.05) in leg girth gains (cm) were found between the C and S groups, respectively ([+3]1.0±0.8 vs 2.6±0.5; [+6]2.3±0.8 vs 2.9±0.5; [+9]2.7±0.8 vs 3.5±0.5; [-3]0.2±0.3 vs 0.9±0.3; [-6]0.9±0.3 vs 1.2±0.3; [-9]0.9±0.3 vs 1.6±0.3; M±SE).
Potential Predisposing Risk Factors for Noncontact Anterior Cruciate Ligament Tears in High School and College Female Athletes
Cyphert L, Denegar C, Leamer P, Cigany R. Slippery Rock University, Slippery Rock, PA 16057

In 1990, Woodford et al reported that high school and college football players may be at risk for noncontact anterior cruciate ligament (ACL) injuries if measurements of navicular drop (ND), passive drawer (PD), and manual maximal drawer (MM) (using the KT-1000 knee arthrometer) are high. The purpose of this study was to determine if ND, PD, MM, and calcaneal eversion (CE) with weight bearing represent risk factors for ACL tears in female basketball players and gymnasts. Eight athletes with unilateral, noncontact ACL tears were matched with eight athletes without ACL tears by sport, position, and playing time in an attempt to minimize differences in exposure to injury. Discriminant analysis with stepwise data entry resulted in four predictor variables (CE, ND, PD, and MM) being retained in the analysis. With the use of the regression equation to predict classification of subjects, 87.5% of the cases were predicted correctly (chi square = 9.0, p<.01). Based on these results, we concluded that high school and college female basketball players and gymnasts may be predisposed to noncontact ACL injuries if measurements of ND, PD, and MM are high and if measurements of CE are low. Additional data is currently being collected in order to explore additional potential risk factors and to further enhance our understanding of ND, CE, PD, and MM as risk factors for ACL tears.

Shoulder Arthrography Following Open Versus Arthroscope-assisted Open Rotator Cuff Repair
Uhl TL, Liu SJ, Baker CL. The Human Performance and Rehabilitation Center, Columbus, GA 31995

The purpose of this study was to use shoulder arthrography to evaluate and...
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compare the methods of repair of the rotator cuff. Shoulder arthrograms were performed on 21 shoulders from 20 patients after either an open (OR) or arthroscopically assisted (AR) open rotator cuff repair. Group OR consisted of 11 shoulders with an average follow-up of 4.5 years (range = 1.8 to 12 yr), and group AR consisted of ten shoulders with an average follow-up of 3.2 years (range = 2 to 4.5 yr). Seventeen of the 21 shoulder arthrograms were abnormal (OR=9, AR=8); nine showed full-thickness tears (OR=6, AR=3), and eight showed partial thickness tears (OR=3, AR=5). Patients' subjective and objective findings were assessed with a visual analog scale (0 to 5) and the UCLA shoulder criteria (0 to 35). Paired t-tests were employed to compare group differences. No significant difference was found between OR and AR for visual analog scale scores (means (ranges) = 1.3 (0 to 3) and 1 (0 to 2), respectively, p>0.05) and the UCLA shoulder evaluation (means (ranges) = 31 (22 to 35) and 33 (31 to 35), respectively, p>0.05). Further, no differences were found between groups in the size of the rotator cuff tear and the functional outcome. In conclusion, AR resulted in fewer full thickness rotator cuff tears and equal functional outcomes in comparison to OR. The size of the rotator cuff defect was independent of functional outcome. Thus, complete water tight closure is not necessary for a good functional result. Arthrograms may not be helpful in determining the cause of shoulder pain or injury following rotator cuff repair.

**Prediction of Academic Achievement in a NATA-Approved Graduate Athletic Training Education Program**

Keskula DR, Perrin DH. University of Virginia, Charlottesville, VA 22903

The purpose of this investigation was to determine which information used in the applicant selection process would best predict the final grade point average of students in a National Athletic Trainers' Association (NATA) graduate athletic training education program. The criterion variable used was the grade point average (GPA) calculated for the completed program of study (36 to 38 credit hours). Five predictor variables were used and represented the criteria used in the applicant selection process. The variables were: Graduate Record Examination-Quantitative (GREQ), Graduate Record Examination-Verbal (GREV), undergraduate grade point average (UGPA), total athletic training hours (hours), and curriculum versus internship program (program). The data of 55 graduate athletic training students who were enrolled in the program during the time period of 1986 through 1990 were evaluated. Ninety-one percent of the students were certified by NATA or eligible for certification at the time of admission. Stepwise multiple regression analysis indicated that UGPA was a significant (p<.001) predictor of GGPA, accounting for 34% of the variance, GREQ, GREV, hours, and program did not significantly contribute individually or in combination to the prediction of GGPA. The results of this investigation suggest that of the variables examined, UGPA is the best predictor of academic success in a NATA-approved graduate athletic training education program. Data obtained from interviews, recommendations, and other sources may be included in subsequent endeavors designed to predict academic achievement. Additional research is required to evaluate variables for predicting clinical proficiency.

**Prediction of Academic Success and Program Completion in a Selective Admissions Athletic Training Curriculum**

Andersen JC, Johanson G, Scaffidi S. School of Health and Sport Sciences, Ohio University, Athens, OH 45701

The purpose of this study was to assess the predictive validity of selected admissions variables to determine initial academic success and program outcome in a selective admissions athletic training curriculum. Initial academic success was defined as freshman year, fall quarter grade point average (FQGPA). Program outcome was defined as either program graduate or program nongraduate. Academic admissions variables selected for analysis were high school grade point average (GPA), percentile rank in class (RIC), American College Test (ACT) score, and year of admission (YR). Multiple regression analyses (standard and backward elimination) were used to determine to what extent the selected admissions variables could predict initial academic success. Logistic regression analysis was used to determine if the selected variables could adequately predict the program outcome of admitted students. Standard multiple regression analysis resulted in a saturated model that could explain 47% of the variation in FQGPA. Backward elimination regression analysis yielded a two variable (ACT and RIC) reduced model that could explain 43% of the variation in FQGPA. Logistic regression analysis resulted in a saturated model that correctly classified 77.8% of program graduates, while only 33.3% of program nongraduates were correctly classified. Overall, the saturated model correctly classified just 58.7% of admitted students into the appropriate outcome category. Using backward stepwise logistic regression, a one variable (ACT) model was identified that correctly classified 86.1% of the program graduates, while only 33.3% of the program nongraduates were correctly classified. For all cases, 63.5% were correctly classified into their appropriate program outcome category using the one variable model. These results indicate that the ability of the variables selected to explain the variation in initial academic success is quite limited. In addition, the selected admissions variables do not adequately predict the program outcome of admitted students.

**The Athletic Trainer's Role in Sports Medicine Centers**

Cornier J, York A, Kegereis ST, Domholdt E. Krannert Graduate School of Physical Therapy, University of Indianapolis, Indianapolis, IN 46227

The purpose of this study was to document practices and opinions of physical therapists (PTs) and certified athletic trainers (ATCs) about the role of ATCs who are employed in sports medicine centers (SMCs). Specifically, we sought to determine whether there are differences regarding the use of ATCs in the SMCs based on whether those centers are located in states that have athletic trainer licensure. Also, we wanted to determine any differences among opinions of ATCs, PTs, and PT/ATCs about the ideal role of the ATC in the SMC. The subjects were 210 ATCs and 210 PTs. These subjects were evenly distributed in three states that have ATC licensure and three states without ATC licensure. A survey mailed to all subjects asked about current ATC utilization practices and about the ideal ATC role in 28 different clinical procedures. A value of five indicated that the ATC did, or should, perform the task independent of the physical therapist. A value of one indicated that
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Intraclass Reliability Estimates for Concentric Muscle Testing With a KinCom 500H Isokinetic Dynamometer

Harter RA, Snow-Harter CM, Shelley A. Department of Exercise and Sport Science, Oregon State University, Corvallis, Oregon 97331

The reliability of isokinetic measurement of spine, hip, and elbow strength has not been well established. Use of the product-moment correlation statistic to determine the test-retest reliability of knee joint isokinetic parameters has been criticized. We estimated the reliability of concentric peak torque and angle of peak torque values during trunk extension, hip abduction, hip adduction, knee extension, and elbow flexion using the intraclass correlation coefficient (ICC) statistic. Nineteen healthy female and male subjects (mean=48.4 yr, range=19 to 69 yr) performed three maximum voluntary contractions for each of the five isokinetic strength tests on two occasions within a 2-week period. Isokinetic testing speed was 15°/sec for trunk extension and 30°/sec for all other tests. We employed repeated measures analyses of variance (ANOVA) to analyze differences among and within subjects and to calculate ICCs. No significant differences were
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present among peak torque test-retest values for any of the five strength tests (p<0.01). Peak torque ICC reliability estimates ranged from .991 (elbow flexion) to .964 (trunk extension). The angle at which peak torque occurred was considerably more variable, as reliability estimates ranged from .814 (elbow flexion) to .400 (trunk extension). Significant differences in the angle of peak torque were observed for elbow flexion, hip abduction, and hip adduction (p<0.01), but not between test-retest values at any joint (p>0.01). Our results indicate that concentric isokinetic peak torque values measured with a KinCom dynamometer at slow speeds are highly reliable across a wide range of testing positions, physical capabilities, and ages of subjects.

Validity of Data Extraction Techniques on the Kinetic Communicator (KinCom) Isokinetic Device
Tis LL, Perrin DH. University of Virginia, Charlottesville, VA 22902

The KinCom (Chattecx, Chattanooga, TN) enables examination of average and peak torque values that are extracted from a smaller range of motion within a larger tested range of motion. However, the validity of this procedure has not been established. Therefore, this study examined the validity of the average and peak torque values of the knee extensor and flexor musculature obtained through the data extraction technique. Twenty females (age=20±1.01 yr, ht=66.6±2.69 in, wt=135±12.3 lb) were assessed for concentric and eccentric isokinetic peak and average torque of the knee extensor and flexor musculature at a velocity of 90°/sec. Subjects were assessed through a range of motion of 5° to 90° and 25° to 70° in random order. Peak and average torque values within a range of motion of 25° to 70° were extracted from the tested range of motion of 5° to 90°. The extracted values were subsequently compared to the average and peak torque values obtained from testing through the 25° to 70° range of motion. Correlational analyses of these comparisons revealed relationships ranging from r=.79 to r=.95. Paired t-tests revealed significant differences (p<.05) between the tested and extracted peak torque values obtained for one of four peak torque measures (concentric knee flexion). However, three of four average torque measures (concentric knee extension, concentric knee flexion, and eccentric knee flexion) were significantly different (p<.05). These findings suggest that peak torque measures obtained through the data extraction technique may be the more appropriate measure to use for data analysis. Despite a strong relationship between the tested and extracted average torque values, significant differences between the measures warrant caution when using extracted average torque values.

Reliability and Comparison of Isokinetic Testing With a Standard Shin Adapter and the Johnson Anti-Shear Device
Roorda BL, Perrin DH. Canisius College, Buffalo, NY 14208, and University of Virginia, Charlottesville, VA 22902

The quadriceps and hamstring muscles are key in providing stability to the knee. The Johnson Anti-Shear adapter (JASA) and the standard distal pad (SDP) are two methods that can be used during isokinetic rehabilitation. This study compared the SDP and the JASA in obtaining knee extension and flexion peak torque (PT), average power (AP), and total work (TW) measures and determined the reliability of these measures. Twelve females (age=19.8 yr, ht=146.0 cm, wt=59.4 kg) with no history or evidence of knee joint pathology were tested once a week for 4 consecutive weeks at 60° and 240°/sec while they were in a seated position. The subjects were randomly assigned for test-retest strength assessment with the JASA or SDP for the first 2 weeks. Test conditions then were reversed for each subject during the last two weeks. Gravity correction was obtained according to manufacturer instructions. Analysis of variance indicated that significantly greater values were generated during testing with the SDP than JASA for quadriceps peak torque at 60°/sec and total work at 240°/sec (p<.05).

No other measures were significantly different between the two devices. Intrainner correlation coefficients (R) were determined for the test-retest measures. Correlation coefficients ranged from .84 to .96 for the JASA and from .85 to .95 for the SDP. Five of the eight values were higher for the SDP. These findings suggest that there are minimal differences in isokinetic assessment using a SDP or the JASA in healthy subjects. However, reliability appears to be slightly better with the SDP. Further research is needed to compare the two devices in subjects with anterior cruciate ligament deficient knees.

Poster Presentations

Habituation to the Perception of the Qualities of Cold-Induced Pain
Ingersoll CD, Mangus BC. Sports Injury Research Laboratory, Indiana State University, Terre Haute, IN 47809

Numerous authors have described a habituation phenomenon to therapeutic ice bath immersions. Athletic trainers assure athletes that their perceptions of the pain induced by a therapeutic ice bath will decrease each day as they proceed through therapy. Essentially, it is assumed that there is a habituation to the perception of cold-induced pain shortly after initiation of the treatment regime. The purpose of this study was to measure the qualities of pain caused by cold immersions over a 5-day period (using the McGill Pain Questionnaire (MPQ)) to determine if habituation to the perception of cold pain occurs. The subjects were 22 male and female college students who had limited experience with cold immersion. The subjects’ right feet were immersed in an ice bath for 21 minutes on 5 consecutive days. The MPQ was used to measure pain during ice bath immersions. Sensory, affective, evaluative, and miscellaneous qualities of pain were determined from the MPQ. During the testing session, each subject completed the MPQ 30 seconds following immersion and then every 3 minutes until completion of the test. Repeated measures analyses of variance (ANOVA), with p values adjusted according to the Bonferroni correction, revealed no significant differences for any of the qualities of pain over a 5-day period. The subjects’ perception of cold-induced pain did appear to decrease during the immersion and there was a trend toward decreasing pain by day 5, but a habituation to the perception of cold-induced pain was not documented in this study.
Student Athletic Trainers’ Knowledge Regarding the HIV and AIDS
Dewald LL. Wilmington College, Wilmington, OH 45177

This research project focused on student athletic trainers and their knowledge regarding the Human Immunodeficiency Virus (HIV) and Acquired Immunodeficiency Syndrome (AIDS). A survey instrument was developed and administered to all student athletic trainers in an undergraduate athletic training curriculum program. Upon statistical analysis of the results, an exemplary HIV and AIDS educational in-service program was developed and implemented successfully. This National Athletic Trainers’ Association presentation outlines the results of the survey and the HIV and AIDS educational program that was developed and implemented throughout the Athletic Training Curriculum Program. It is a model that all athletic training settings can use to educate students about the HIV and AIDS.

A Three-year Study of High School Athletic Injuries
Sauers RJ, Syrstad S. Sports Medicine Lehigh Valley, Bethlehem, PA 18017

The purpose of this ongoing study is to understand the epidemiology of high school athletic injuries. Through a clinic-based athletic trainer outreach program, injury data was collected for 3 years from ten different high schools. A certified athletic trainer collected data from each high school and entered it into a central computer using the Alfie software program. An injury was reported if it required medical attention or caused a loss of practice and/or game time. A total of more than 2500 injuries has been recorded in 3 years. The majority of the injuries occurred during practice (58%). Of the 21 sports from which data was collected, football had the highest injury occurrence at 33%, followed by wrestling (17%) and men’s basketball (11%). The majority of injuries to women occurred in basketball (7%). The average number of practices missed per injury was 2.96, while the average number of games missed per injury was .69. The number of injuries during practice, the reinjury rate, and the time lost as a result of significant injuries clearly shows justification for the presence of certified athletic trainers not only at games, but at practices as well.

Casting in Sport: A Biomechanical Analysis of Protective Materials
Malone KN, Darmelio JP, DeCarlo MS, Rettig AC. Methodist Sports Medicine Center, Indianapolis, IN 46202

The purpose of this investigation was to determine the most appropriate material to use in constructing playing casts for hand and wrist injuries by: (1) assessing the hardness of protective materials, and (2) measuring the energy absorption of different materials used for casting and protection. Twenty readings on seven types of nonporous, protective materials and the dorsal surface of a bare hand were taken from random points using a
Shore Durometer. (A Shore Durometer is an instrument used by engineers to determine the hardness of rubber materials.) A drop point test to measure the energy absorption of 12 materials was conducted using a Kistler force platform (model 9281 B). The test consisted of dropping a steel ball (m=0.866 kg) from a trap door onto the sample of material that covered the surface of the platform. The ball was dropped from heights of 30, 60, and 100 cm. Impact readings were taken for 39 trials (3 heights x 13 conditions). Peak vertical force at impact was recorded in Newtons by the force platform at 1,000 Hz. A one-way analysis of variance (ANOVA) of the durometer readings revealed no significant difference in hardness (p>0.05) between a scout cast, a leather glove, and tape. Bare flesh and a forearm pad were significantly softer (p<0.05) than all of the other materials. The RTV11 foam, fiberglass, and orthoplast materials were each significantly harder (p<0.05) than all of the other materials. A two-way analysis of variance (ANOVA) of the drop point test data revealed that the RTV11 foam material and the RTV11 foam/tape material absorbed significantly more force (N) (p<0.05) than the scout cast, fiberglass, orthoplast, and felt materials. The 1-inch foam absorbed significantly more force (p<0.05) than the fiberglass, felt, forearm pad, and scout cast materials. Statistical analysis also revealed a significant difference (p<0.05) in energy absorption (N) among each of the impact heights. These results suggest that, when used to protect a hand or wrist injury, the playing cast material best suited to provide a combination of internal immobilization of the injury (hardness) and external protection from impact forces (energy absorption) would be the RTV11 foam or RTV11 foam/tape combination.

Because of the properties of fat, it would appear that ultrasound would have little trouble passing through it. This ability for ultrasound to penetrate or “attenuate” fat has been tested in animals such as pigs, but has not been tested in humans. The purpose of this study was to compare tissue temperature rise (TTR) during ultrasound treatments in humans who have less than 10mm of subcutaneous fat versus those with more than 10mm of subcutaneous fat in the lower leg. Twenty males (mean age=23 yr) served as subjects. Skinfolds were taken of the medial gastrocnemius area. Subjects assigned to the “short” group had skinfolds of <10mm (range 4 to 9) while subjects with skinfolds of more than 10mm (range=11 to 30) were assigned to the “not short” group. A 23-gauge hypodermic needle microprobe was inserted 3 cm deep into the medial portion of the anesthetized gastrocnemius muscle of each subject. The needle thermister was then connected to a monitor. Fifteen milliliters of ultrasound gel was applied to a target area 10 cm in diameter. Continuous ultrasound was delivered topically at 1.5 W/cm² for 10 minutes. During this time, the soundhead was moved at a speed of 4 cm/sec, and the temperature was recorded every 30 seconds. The mean baseline temperature for each group was 35.5°C. The lean group’s temperature increased to 36°C during ultrasound treatment, while the fat group remained at 35°C. The lean group’s temperature reached a plateau at a mean of 40.2°C, while the not lean group reached a nearly identical temperature of 40.3°C. This resulted in no significant difference (p>0.05) and substantiates the claim of Grothus and Draper. Because subcutaneous fat does not serve as a barrier to therapeutic ultrasound, athletic trainers and physical therapists can effectively use this modality to increase muscle temperature in endomorphic humans.

Effect of Sport Ankle Orthoses on Range of Motion and Torque Production During Ankle Motion
Kimura I, Beninato P, Sitler M. Temple University, Philadelphia, PA 19103

The purpose of this study was to investigate range of motion and peak torque output at the ankle joint during plantar flexion, dorsiflexion, inversion, and eversion in three experimental conditions: (1) wearing nothing applied to the ankle (a control condition); (2) wearing the Swede-O-Universal Ankle Support; and (3) wearing the Air-Stirrup Sport Stirrup. Testing involved goniometrically measuring ankle range of motion followed by testing on the Cybex II Isokinetic Dynamometer, followed by remeasuring ankle range of motion. The three trials were randomized. Twenty uninjured, pain-free male subjects participated in the study. Prior to each subject’s test trials, a practice session on the Cybex II was administered to familiarize the subjects with the isokinetic testing device. Testing involved goniometrically measuring left ankle plantar flexion, dorsiflexion, inversion, and eversion followed by six maximal plantar flexion/dorsiflexion and inversion/eversion repetitions on the Cybex II. Goniometric measurements were again taken following Cybex testing. Each test trial was separated by a 5-minute rest period. One way analyses of variance (ANOVA’s) with repeated measures were used to examine the differences among test conditions for ankle range of motion and peak torque measurements. The F-test revealed significant differences at the p<.01 level in range of motion and torque production for three conditions. A Simple effects test was performed to determine significant differences at the p<.01 level, in range of motion between trial conditions. The results indicate significant differences in planar flexion, dorsiflexion, inversion, and eversion between trials using the Swede-O-Universal Ankle Support and trials using nothing applied to the ankle. Significant differences in dorsiflexion, inversion, and eversion were found between trials using the Air-Stirrup Sport Stirrup and trials using nothing applied to the ankle. The results also indicate that all ankle motions were significantly less when subjects wore the Swede-O-Universal Ankle Support than when subjects wore the Air-Stirrup Sport Stirrup. A Scheffe post hoc test was performed to determine significant differences at the p=.05 level in peak torque output between trial conditions. The results indicated that subjects produced significantly less torque in plantar flexion, dorsiflexion, inversion, and eversion when wearing either the Swede-O-Universal Ankle Support or the Air Stirrup Sport Stirrup than when wearing nothing applied to the ankle. Torque production during plantar flexion and dorsiflexion was significantly less when subjects wore the Swede-O-Universal Ankle Support than when subjects wore the Air Stirrup Sport Stirrup.

The Law of Grothus-Draper Revisited: Does Ultrasound Penetrate Subcutaneous Fat in Humans?
Sunderland S, Draper DO. Illinois State University, Normal, IL 61761

One benefit that ultrasound has when compared to infrared modalities is its ability to penetrate subcutaneous fat. According to the Law of Grothus-Draper, ultrasound: (1) penetrates through tissues of high water content; (2) is absorbed in tissues high in protein; (3) reflects off of bone; and (4) refracts off of joint junctions.

Because of the properties of fat, it would appear that ultrasound would have little trouble passing through it. This ability for ultrasound to penetrate or “attenuate” fat has been tested in animals such as pigs, but has not been tested in humans. The purpose of this study was to compare tissue temperature rise (TTR) during ultrasound treatments in humans who have less than 10mm of subcutaneous fat versus those with more than 10mm of subcutaneous fat in the lower leg. Twenty males (mean age=23 yr) served as subjects. Skinfolds were taken of the medial gastrocnemius area. Subjects assigned to the “short” group had skinfolds of <10mm (range 4 to 9) while subjects with skinfolds of more than 10mm (range=11 to 30) were assigned to the “not short” group. A 23-gauge hypodermic needle microprobe was inserted 3 cm deep into the medial portion of the anesthetized gastrocnemius muscle of each subject. The needle thermister was then connected to a monitor. Fifteen milliliters of ultrasound gel was applied to a target area 10 cm in diameter. Continuous ultrasound was delivered topically at 1.5 W/cm² for 10 minutes. During this time, the soundhead was moved at a speed of 4 cm/sec, and the temperature was recorded every 30 seconds. The mean baseline temperature for each group was 35.5°C. The lean group’s temperature increased to 36°C during ultrasound treatment, while the fat group remained at 35°C. The lean group’s temperature reached a plateau at a mean of 40.2°C, while the not lean group reached a nearly identical temperature of 40.3°C. This resulted in no significant difference (p>0.05) and substantiates the claim of Grothus and Draper. Because subcutaneous fat does not serve as a barrier to therapeutic ultrasound, athletic trainers and physical therapists can effectively use this modality to increase muscle temperature in endomorphic humans.
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Effects of Adhesive Spray and Prewrap on Taped Ankle Inversion Before and After Exercise

Keech AK, Johnson MB, Allsen PE, Durrant E. University of Utah Sports Medicine Center, Salt Lake City, UT 84112

The purpose of this study was to investigate the effects of adhesive spray and prewrap on taped ankle inversion before and after exercise. The subjects were nine females and seven males who had no neurological conditions, lower extremity fractures, disease or surgery of the lower limb, or history of lower limb injury in the past 12 months, and had suffered no more than two ankle sprains to either ankle. One taping configuration was applied using four methods: spray and prewrap, spray only, no spray or prewrap, and prewrap only. Subtalar ankle inversion was evaluated using high speed cinematographic techniques and an inversion platform that suddenly inverts the ankle to 35°. Three trials were measured before and after 16 minutes of figure-of-eight running and 20 unilateral heel raises. All four taping methods significantly reduced inversion before and after exercise. Inversion restriction following exercise was greater for taping methods that did not use prewrap (p=.069). The method offering the greatest restriction employed spray without prewrap.

Isometric Torque Production of Knee Flexors/Extensors in Recreational Athletes

Noteboom JT, Horuchi D. Therex-Greenwood, Denver, CO 80111

Adult recreational athletes commonly are seen in the clinical setting with knee symptoms. Muscle testing is frequently used to determine the relative strength of the knee flexor and extensor muscles. Normative data for isometric torque production of recreational athletes between the ages of 20 to 40 is lacking. The purpose of this investigation was to determine the isometric torque production of the knee flexors and extensors in recreational athletes. Twenty females (age=26.4±5.0 yr, wt=121.1±12.9 lb and 20 males (age=25.0±4.1 yr, wt=180.1±24.2 lb) were evaluated using a Biodex dynamometer. All subjects were active in regular exercise programs, had no knee pathologies, and were right leg dominant. The subjects were tested at 60° knee flexion. Testing involved three maximal 5-second contractions for the knee extensors and flexors of each knee. Analyses of variance (ANOVA) were used to determine significant differences (p<0.05) in mean test results. As expected, the males produced significantly greater torque (in ft-lb) for the knee flexors (107.6±18.7) and extensors (149.8±24.5) when compared to the females: knee flexors (66.1±14.9) and extensors (90.7±20.1). However, when presenting the torque data as a ratio of torque/body weight, the differences between males and females were insignificant, although a trend toward increased scores for the males remained. When comparing the data for dominant versus nondominant legs—for both muscle groups for males and females—there was a tendency for the dominant leg to produce greater torque, but these differences were insignificant.

Relationship Between Knee and Ankle Isokinetic Peak Torques and Vertical Jump Performance in Selected Intercolligate Basketball Players

Taylor J, Brown J, Chaffin W. Pfeiffer College, Misenheimer, NC 28109

The relationship between vertical jump performance and various strength measures has been studied previously by several researchers. There has been no consensus about whether a correlation exists and, if so, where the relationship lies. The purpose of this study was to determine if a relationship exists between vertical jump performance and knee and ankle isokinetic peak torques. The vertical jump performance of 12 intercollegiate basketball players was determined by using the Sargent Jump Test. Each of the subject’s highest jump score was converted into power output by using the Lewis formula. Knee and ankle strengths (knee flexion/extension; ankle plantar flexion/dorsiflexion) were determined by using the Cybex II Isokinetic Dynamometer. Pearson product correlation coefficients were computed to determine if a relationship exists between the power outputs and the isokinetic peak torque measures. A significant, positive correlation was found between knee extension (60°/sec) and power output (r=.90, p<.01). It was concluded that for the muscle groups tested, the strongest relationship between muscular activity and vertical jump performance occurs in the knee extensors. This information may be of use when designing conditioning programs for those athletes who include jumping as an integral part of their sport activity.

The Effects of Hip Position and Angular Velocity on Quadriceps and Hamstring Peak Eccentric Torque and Hamstring/Quadriceps Ratio Values

Hopkins J, Sitter M, Ryan J. Temple University, Philadelphia, PA 19122

The purpose of this study was to determine the effects of hip position and angular velocity on quadriceps and hamstring peak torque and on the hamstring/quadriceps (H/Q) ratio during maximal eccentric force. The dominant knees of 14 subjects (7 male, 7 female, mean age = 23.5 yr) who had no prior history of knee injury were tested in seated (110° hip flexion) and supine (10° hip flexion) positions at velocities of 60° and 180°/sec. Testing was completed using the Kinetic Communicator isokinetic dynamometer. The single highest torque of five maximum repetitions (gravity corrected) for each test trial served as the criterion value. Data analysis consisted of two analyses of variance (ANOVA) with repeated measures on all factors for the dependent variables of peak torque and H/Q ratio and showed the following: (1) The quadriceps (p<.001) produced significantly greater peak torque than the hamstrings. (2) Both muscle groups produced significantly greater peak torque in the seated position (p<.001) than in the supine position, and at 180°/sec (p<.05) than at 60°/sec. (3) H/Q ratios were significantly greater in the seated position (p<.001) than in the supine position, and at 180°/sec (p<.05) than at 60°/sec. The findings of this study indicate that the quadriceps and hamstring peak eccentric torque and H/Q ratio are influenced by hip position and angular velocity. Furthermore, these findings have clinical implications for the isokinetic eccentric testing and screening of the knee musculature.

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The Effects of Speed Progression Order on Average Power and Torque Production During Isokinetic Velocity Spectrum Exercise
Kovaleski JE, Heitman RJ, Scaffidi FM, Fondren FB. University of South Alabama, Mobile, AL 36688

The objective of this study was to examine the influence that the order of speed progression has on average power and torque production during different isokinetic velocity spectrum exercise (VSE) sessions. Twenty-two subjects were randomly assigned to four exercise protocols that were separated by 1 week, with each containing an isokinetic training session involving the dominant knee extensor. Each protocol consisted of performing two sets of ten repetitions at speeds of 30°, 90°, 150°, and 210°/sec in varying VSE order. Muscle function was assessed using the LIDO Active. Average torque (Nm) and power (joules/sec) were used to make the comparisons. A multivariate analysis of variance (MANOVA) revealed a significant difference (p<.05) for the main effects of protocol and speed for both average torque and power. More importantly, a significant interaction (p<.05) was found between protocol and speed for both average torque and power. Post hoc analyses for torque and power showed similar results. Consistent differences were found between protocols at all speeds except the 90° speed of protocol three (where the slower speeds were performed first), which was significantly (p<.05) inferior to the others. These results seem to imply the superiority of performing faster speed sets initially in the VSE trial. Performance of fast speed training prior to progressing to slow speed training is recommended when power or torque production is important.

The Effect of Static Stretching and PNF Stretching on Concentric and Eccentric Isokinetic Torque Values of the Shoulder Rotators
Steckley PL, Dolan MG, Reeds GK. Department of Physical Education, Canisius College, Buffalo, NY 14208

The purpose of this study was to determine the effect of static stretching and proprioceptive neuromuscular facilitation (PNF) stretching prior to exercise on peak torque and average torque values of concentric and eccentric isokinetic testing of the shoulder's rotator muscles. Thirty-four male college ice hockey players (age=19.1±1.18 yr, ht=178.7±4.9 cm, wt=82.4±8.28 kg) who attended training camp and reported no previous history of shoulder injury served as subjects. Prior to testing, each subject received an orientation session to acquaint him with the concentric and eccentric contractions of the isokinetic dynamometer (KinCom, Chatecx Corp.) Each subject reported for two test sessions. The first test session consisted of two minutes of static towel stretching of the internal and external rotators. Subjects were positioned on the KinCom in 40° of glenohumeral abduction and tested in the plane of the scapula, 30° anterior to the frontal plane. Subjects performed three submaximal concentric and eccentric warm-ups on the KinCom at 60°/sec. The subjects then were tested at 60°/sec for the internal and external rotators of the shoulder. The second test session consisted of two minutes of PNF stretching
that preceded the same KinCom warm-up and testing procedure. Peak torque and average torque values in Newton meters (Nm) were obtained for each subject for both test sessions. The data were analyzed using the Wilcoxon t-Test to determine if the subjects differed in the two performance conditions. Each subject served as his own control in this research design. The results indicated no significant difference in torque production between the two stretching protocols (p>0.05). Results of this analysis suggest that neither static nor PNF stretching appear to have a significant effect on torque values of isokinetic performance of the shoulder rotators.

The Incidence of Chronic Fatigue Syndrome and Related Disorders in College Athletes, 1987 to 1991
Cramer CR. Barry University, Miami Shores, FL 33161

Athletic trainers at all 847 NCAA-sponsored institutions were queried about the incidence of chronic fatigue syndrome, fibromyalgia, myalgic encephalomyelitis, clinical depression, panic disorder, and infectious mononucleosis in their athletes during the time period of 1987 to 1991. The 28% response rate to the survey represented more than 50,500 athletes. The average time lost from participation for those involved also was observed. During 1987 to 1991, infectious mononucleosis was observed at a mean rate per thousand of more than ten times the incidence of the other five illnesses combined (5.16/1000). The second highest combined mean incidence was observed with clinical depression (.57/1000), which included two deaths. The third highest incidence was observed with chronic fatigue syndrome or neurasthenia (.28/1000). Panic disorder had the fourth highest incidence (.18/1000), with fibromyalgia (.14/1000) and myalgic encephalomyelitis (.02/1000) observed as fifth and sixth in descending incidence. Time lost from participation for all illnesses combined was 0 to 10 weeks for 82% of the reported cases, 11 to 20 weeks lost for 12% of the cases, and more than 20 weeks lost for the remaining 6% of the cases. The extremely low incidences of illness observed in this study should not diminish the need for close medical monitoring of all athletes presenting with severe and/or prolonged fatigue. Athletic trainers and team physicians must maintain close observation and documentation of involved athletes. This is especially important for fatigued athletes who test negative for infectious mononucleosis.

Vascular Supply of the Human Anterior Cruciate Ligament
Toy BJ, Yeasting RA, Morse DE, McCann P. The Medical College of Ohio and The University of Toledo, Toledo, OH 43606

The arteries of a fresh cadaver knee were injected with a lead oxide solution and subsequently immersed in 10% formalin for a 2-week period. The vasculature of the anterior cruciate ligament (ACL) was examined by dissection. A second specimen was prepared similarly and was subjected to a CAT scan. ACL vascularization arises from the middle genicular artery and vessels of the infrapatellar fat pad and adjacent synovium. The middle genicular artery, a branch of the popliteal, penetrates the posterior joint capsule and courses along the dorsal aspect of the ligament. The artery gives rise to ligamentous branches to the ACL as it courses within the synovial membrane that covers the ligament. These ligamentous branches form a web-like network of periligamentous vessels within the synovial membrane. Periligamentous vessels give rise to connecting branches that penetrate into the ligament transversely and Anastomose with a network of longitudinally-oriented periligamentous vessels. The inferior medial and lateral genicular arteries may aid in the formation of the membrane’s web-like network by connecting with periligamentous vessels. Terminal branches of the inferior genicular arteries supply the distal portion of the ACL directly. While the middle genicular artery branches to the distal femoral epiphysis and proximal tibial epiphysis, ligamentous-osseous junctions of the ACL do not significantly contribute of the ligament’s vascularity. The extremities of the ACL seem to be better vascularized than the middle part. The proximal portion seems to have a greater vascular density than the distal portion.

A Multi-center Comparison of Rehabilitation Protocols in 1150 Anterior Cruciate Ligament Reconstruction Cases
Blair DF, Wills RP, Feagin JA, Collins HR, Wenatchee Valley Clinic Sports Medicine Center, Wenatchee, WA 98801

A multi-center study was undertaken to evaluate the long-term results of the various anterior cruciate ligament reconstruction (ACLR) rehabilitation protocols. A total of 1150 ACLR cases were reviewed; 980 of these were surgeries using intra-articular bone-patellar tendon-bone autografts without extra-articular reconstructions. They were performed by members of the American Orthopedic Society for Sports Medicine. The standard postoperative protocol in the late 1970s included 6 weeks of casting and non-weight-bearing ambulation. In the early 1980s, more aggressive rehabilitation procedures were instituted, including early weight bearing and early motion. Patients progressed from partial weight bearing to full weight bearing within 2 weeks postoperatively. Early range of motion, including immediate, postoperative continuous passive motion with a long-lasting regional anesthetic and aggressive passive extension, was started immediately following surgery. The rehabilitation protocols became more aggressive in the late 1980s and early 1990s and led to a more rapid return to activities. Patient satisfaction has improved significantly with earlier motion and weight bearing. A more rapid return to work and sports is possible. Incidence of reoperation for manipulation and debridement has been reduced. Intra-articular scar formation leading to tighter than normal laxity scores, flexion contractures, and postoperative patellofemoral arthralgia is very uncommon with earlier motion. Following more aggressive rehabilitation, knee laxity testing has demonstrated a slight deterioration in mean laxity scores (2.7 mm to 3.5 mm), but no significant increase in “laxity failures” (>5 mm side-to-side difference at 30 pounds or maximum load). Based upon our findings, our young athletic patients have successfully returned to their sport in four to six months postoperatively, when their strength, proprioception, and functional abilities show that rehabilitation is complete.
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Rib Stress Fractures: An Overview
Wasik M, McFarland EG. University of Florida Athletic Association, Gainesville, FL 32604

Stress fractures of the ribs are very uncommon in athletes. As a result, this diagnosis often is not considered or is missed. The purpose of this study was to review our experience with this entity and compare it to available literature on these fractures. Rib stress fractures are believed to be caused by the pull of the scalene muscles on the first rib. They have been described in basketball players, baseball pitchers, tennis players, and weight lifters. In this study, we reviewed four cases of first rib stress fractures in a 13-year-old weight lifter, a 16-year-old male weight lifter, and a 20-year-old male baseball player. All patients had nonspecific shoulder pain for an extended period of time (average of 8 months) prior to the definitive diagnosis. The diagnosis was made from plain X-ray films in three patients and a bone scan in one. The fractures healed in all but one patient. This nonunion is only the second reported case of a nonunion of a first rib stress fracture. All athletes eventually were able to return to sports with no limitations. Stress fractures of ribs other than the first rib are unusual. "Golfer’s rib" is a stress fracture of the ribs posteriorly, near the vertebral attachments. In this study, a collegiate golfer presented with lateral chest wall pain that developed secondary to increased use of a training device. A stress fracture was diagnosed using a bone scan. The fracture healed, but prevented full participation by the golfer in championship tournaments. Stress fractures in swimmers have never been described; however, during the period of this study, a posterior seventh rib stress fracture occurred in an Olympic level swimmer who had persistent shoulder pain caused by swimming. Diagnosis was made using a bone scan, and the swimmer recovered uneventfully after rest. We conclude that rib stress fractures are unusual entities, but should be considered in athletes who have chronic shoulder or rib cage pain.

Injury Patterns and Risk Characteristics of Female Collegiate Gymnasts
Schaack F, Petrone F, Cox L. Department of Human Services, George Mason University, Fairfax, VA 22030

The objective of this project was to determine type, extent, event, and precipitating stunt/activity of injuries of female collegiate gymnasts during the 1989-1990 season. Of the 29 schools that voluntarily participated in this project, ten completed the monthly injury report survey. Schools were identified by a four-digit code number and each athlete received a four-digit number known only to that school. The ten schools reported the following: Total injuries=414; Areas of the injuries - ankle (20.7%), back (16.3%), knee (14.3%), leg (11.1%), foot (8.5%), shoulder (8.2%); Events during which injury occurred - floor (27.2%), uneven parallel bars (23.8%), balance beam (19.5%), vault (10.3%), unknown (19.2%); Area of body affected and event: uneven parallel bars - shoulder (33.9%), balance beam - ankle (22.6%), floor exercise - ankle (36.5%), vault - knee (24.1%), unknown - back (25%). There were 20 season-ending injuries - eight knee, seven foot/ankle, two shoulder, one each for tibia, elbow, and finger. Double backs (3) and double full twists (3) were the specific stunts most involved in season-ending injuries. Causal relationships cannot be confirmed at this time; however, the following is suggested to avoid injuries in gymnastics: (1) Develop year-long strength programs, especially for ankles and knees. (2) Watch for fatigue in athletes, especially during dismounts and twisting stunts. The continued collection of data of this nature on a large-scale, multi-institutional, longitudinal basis is (and has been) strongly recommended.

Injuries in Competitive Female Swimmers as a Result of Cross-training
Wasik M, McFarland EG. University of Florida Athletic Association, Gainesville, FL 32604

Cross-training has many purported advantages, but we recently have observed a high incidence of injuries in athletes, particularly swimmers, related to cross-training. The goals of this study were to evaluate the distribution of orthopaedic injuries in our female swimmers, to identify those body areas at risk, and to identify those activities that cause the most injuries. The training room records and office medical records of our Division I collegiate female swimmers (N=79) were reviewed for all athlete trainer and physician contacts regarding musculoskeletal problems from 1984 to 1991. There were 125 injuries, an average of 18 per year. Forty-five percent (N=56) were the result of sport-related training, 44% (N=55) resulted from cross-training, and 11% (N=14) were the result of causes unrelated to training. The areas most often injured because of sport-related training were shoulder (55%), knee (11%), lower back (11%), and face (7%). The areas most often injured because of cross-training were leg (24%), low back (18%), thigh (11%), and knee (11%). All of the leg injuries were shin splints except one tibial stress fracture. The ratio of upper extremity to lower extremity injuries for sport-related training was 3:1, and for cross-training, it was 1:4. The most common etiology of cross-training injuries was running (47%), strength training (24%), and performing on stadium steps (13%). Medication was used in 48% of the sport-related training injuries and in 36% of the cross-training injuries. Three operations were performed because of cross-training injuries—two meniscectomies and one lumbar discectomy, the latter a career-ending injury. We conclude that cross-training must be used judiciously and with proper supervision in this patient population. Similar injuries resulting from cross-training have been seen in athletes of other sports at our institution. Further study of the benefits of cross-training in swimming and other sports is warranted.

Nutritional Knowledge, Attitudes, and Practices: Their Relationship to the Actual Dietary Intakes of Female College Athletes
Lundell, LR. The University of Alabama, Tuscaloosa, AL 35487

The objective of this study was to evaluate and examine the relationship between actual dietary intakes of female college athletes and their nutritional knowledge, attitudes, and practices. Data for the study were obtained from a 3-day food record that measured actual dietary intake and a validated questionnaire that measured the knowledge, attitudes, and practices of the 34 varsity athletes. Stated hypotheses were tested using Pearson
correlation coefficients. Results of the study indicated that the female athletes had adequate dietary intakes, although the consumption of several selected dietary components did not meet the recommended standards. Mean energy (kcal) intake fell below the recommended allowance, but protein intake was adequate. Fat intake for most athletes was below the current guideline of 30% of total calories. Of particular concern were the low intakes of fiber, calcium, zinc, and complex carbohydrates. Scores on the knowledge test averaged 50.5%, and attitudes and practices concerning nutrition were positive. Nutritional attitudes were positively associated with dietary intake and nutritional knowledge and practices. However, no correlation was found between nutritional knowledge and dietary intake or practices.

It was concluded that female varsity athletes might benefit from nutrition intervention that addresses an awareness of the importance of adequate energy intakes to ensure adequate protein, vitamins, minerals, and fiber and the selection of nutrient-dense foods to maintain nutritional adequacy, particularly for those with lower caloric intakes.

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**Bone Mineral Density in a College Female Track Team**

Knight C, Pare J, McFarland EG, Kelleher L, Graves JE, Pollock ML. University of Florida Athletic Association, Gainesville, FL 32604

The purpose of this study was to evaluate the bone mineral density (BMD) of collegiate female track athletes and particularly to determine the relationship between the BMD of the axial and appendicular skeleton. Previous studies have reported the BMD of the spine in female runners. However, regional BMD has not been evaluated in female varsity track athletes. The mean age was 25.3 years (range=19-31). Mean height was 167.7 cm, and mean body weight was 62.2 kg. Mean body fat percentage was 25.4% (range=19-33). The BMD for the lumbar spine and distal radius was determined using a Hologic QDR-1000 densitometer. The lumbar spine and distal radius were measured in patients with no systematic difference in BMD between genders. The mean BMD was 1.20 g/cm² for the lumbar spine and 0.90 g/cm² for the distal radius. The mean body fat percentage was 25.4% (range=19-33). The mean BMD was 1.20 g/cm² for the lumbar spine and 0.90 g/cm² for the distal radius. The results indicate that female varsity athletes might benefit from nutrition intervention that addresses an awareness of the importance of adequate energy intakes to ensure adequate protein, vitamins, minerals, and fiber and the selection of nutrient-dense foods to maintain nutritional adequacy, particularly for those with lower caloric intakes.
been reported in subgroups of throwers, sprinters, and distance runners. A detailed activity history and menstrual history were taken, and a physical examination was performed on each of the 30 college female track athletes. Whole-body BMD was performed on each subject using dual energy X-ray absorptiometry (Lunar DPX-L). Athletes were divided into throwers (shot, discus, N=11), sprinters (400 m or less, N=7), and distance runners (800 m or longer, N=15). Throwers differed from the distance runners for percent fat, total body calcium, and BMD of the spine (L 2-3), pelvis, femoral neck, Ward's triangle, and legs (Table, see page 157). Sprinters differed significantly from runners only for the BMD of pelvis and spine (L 2-3) (p<0.05). Menstrual dysfunction did not explain the observed differences (chi square p>0.05).

Although the BMD values were highly correlated among different anatomical locations (r=0.59 to 0.94, p<0.01), regional differences exist among subgroups of track athletes. In conclusion, female college throwers, sprinters, and distance runners differ slightly in their BMDs.

Employment Characteristics of Collegiate Athletic Trainers in the Western United States

Mangus BC, Golden G, Tandy R, Koloskie J. University of Nevada, Las Vegas, NV 89154

The objective of this study was to examine the various types of employment parameters and characteristics of athletic trainers in colleges and universities in the western United States. Additionally, we were interested in determining if there was a standard employment procedure with job description, grievance procedure, contract, pay scale, etc. We developed a survey tool that was first tested on local athletic trainers. Two copies of the survey were mailed with a self-addressed, stamped envelope to all colleges and universities in NATA Districts 4 and 5 offered salaries significantly lower ($21,162) than Districts 6 and 7 ($26,027) and Districts 8 and 10 ($25,791) when all job description salaries were averaged. These results show mean annual salaries for entry-level positions. Further studies are recommended to establish salary norms and trends for entry-level positions.

Entry-level Annual Salaries for Athletic Trainers

Moss CL. Bowling Green State University, Bowling Green, OH 43403

The purpose of this study was to examine the salaries at the clinics, high schools, and colleges/universities for entry-level athletic trainers. Entry level was defined as a certified athletic trainer with no experience. A master’s degree was required for college/university employment. According to the “Placement Vacancy Notice,” June 15, 1990, and June 1, 1991, published by the National Athletic Trainers’ Association, there were 45 vacancies in colleges and universities, 51 in high schools, and 55 in clinical settings. A survey was designed and mailed to the institutions that had these 151 vacancies. Percentages returned were 76% (34), 53% (27), and 82% (45) for college/university, high school, and clinic, respectively. The table represents the rank of entry-level annual salaries offered by position.

The results indicated that the salary for position #1 was significantly higher than for positions #4 through #7. Position #7 had a salary offer significantly lower than #1 and #2. There was no significant difference in the entry-level salary offered to certified athletic trainers who had a master’s degree versus those with a bachelor’s degree. Results also showed that NATA Districts 4 and 5 offered salaries significantly lower ($21,162) than Districts 6 and 7 ($26,027) and Districts 8 and 10 ($25,791) when all job description salaries were averaged. These results show mean annual salaries for entry-level positions. Further studies are recommended to establish salary norms and trends for entry-level positions.
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Therapists and trainers such as Dick Martin of the Minnesota Twins, Herm Schneider of the Chicago White Sox, Mark Pfeil of the Milwaukee Bucks, Tony Harris of the Philadelphia 76ers, Lindsay McLean of the San Francisco 49ers, Greg Johnson, former PGA Tour trainer and many health care professionals use the Saunders S’port All to treat and prevent back injuries to their players. They realize that a back support is only effective if it remains in place during vigorous activity.

The S’port All is available in S (28-30), M (32-34), L (36-38), X-L (40-42) and XX-L (44-46), black or white, with or without fly and retails for $89.99. The professional price is $59.95 with quantity discounts. Plus shipping and handling.

“The message I want to get out is that the S’port All back support is for everyone, not just the professional athlete. We have many satisfied wearers from all walks of life - truck drivers, factory workers, accountants, clerks-- anyone with a back problem should try it. It works for prevention too!”

H. Duane Saunders, M.S., P.T.

Worn by Payne Stewart 1991 U.S. Open Champion
Use of Alternative Handouts and Student Note Taking to Improve Classroom Teaching and Learning in Athletic Training Education
Putman LA, Cyrs TA. New Mexico State University, Las Cruces, NM 88003

The quality of teaching and learning in athletic training education can be improved by using alternative forms of handouts to assist students with note taking. Seventeen alternative methods have been identified by the Center for Educational Development and adapted for use by the Athletic Training Education Program at New Mexico State University. Of the seventeen alternatives, three will be presented. By constructing word pictures (a graphic representation of ideas, concepts, data, and numbers that uses simple line art, geometric shapes, clip art, symbols, arrows, underlining, textual clues, and color to show relationships), labeled diagrams (a critical diagram is provided, and the student is required to complete labeling from the lecturer's comments in order to understand), and interactive study guides (the use of word pictures to show relationships and sequence of ideas), the instructor is able to improve the lecture presentation and to focus attention on critical points. The fall 1989 course in therapeutic modalities did not use the alternative handout presentation, the fall 1990 and 1991 courses did use word pictures, labeled diagrams, and interactive study guides. A comparison of student evaluations and test scores between the fall 1989 course and fall 1990 and 1991 courses provides evidence of mastery of therapeutic modality-related competencies as listed in the National Athletic Trainers' Association "Competencies in Athletic Training." These handouts enable the student to focus on the new material during the presentation without the time-consuming task of writing everything that the instructor is saying. The completed handouts also provide a study guide for the students. Once these handouts are prepared by the instructor, they can be updated and used again.

A Curriculum: The Undergraduate Sports Medicine Inservice Program at the University of Virginia
Sammarone PG, Keskula DR, Gieck J, Saliba E, Foreman S. University of Virginia, Charlottesville, VA 22903

Traditionally, internship programs in athletic training have been relatively unstructured; however, with the adoption of the American Medical Association's Committee on Allied Health Education Accreditation (CAHEA) requirements for education, some program directors may wish to examine and compare their programs with those established at other institutions. The curriculum for the University of Virginia's Undergraduate Sports Medicine Inservice Program was developed to provide learning experiences through which undergraduate students, not involved in an NATA-approved curriculum, would be able to: (1) obtain both technical and advanced clinical skills to maximize their learning experiences; (2) assist with the daily operations of the athletic training room; and (3) further develop their critical thinking skills to enable them to function with minimal supervision as preprofessionals in an allied health setting. This competency-based curriculum was developed using the 1989 Role Delineation Study, the competencies established by the Professional Education Committee (PEC) for internship programs, and the University of Virginia's Undergraduate Sports Medicine major in order to identify those subject areas and skills in which undergraduate students were lacking information and instruction. Curricular objectives and instructional guidelines were created specifically to meet those needs, and minimum competency standards were established for that specific program. The curriculum was implemented in the fall of 1991. This poster presentation highlights the curriculum as it currently exists.

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An Overview of Selected State Licensure Athletic Training Laws

ABSTRACT: With the growth of athletic training, many state governing bodies have created regulations concerning the role of athletic trainers in their respective states. Although many states have similar requirements, each state differs in its legislation that affects various athletic training domains. Athletic trainers should be aware of these variances in state licensure laws, especially when seeking employment in another state. In May 1991, a survey of the 20 states with licensure laws was conducted to examine application procedures, scope of practice, and other factors related to the licensing of athletic trainers.

The profession of athletic training has grown steadily in number of members, scope of knowledge, and respect as a profession. The recognition of the athletic trainer’s increased responsibility in the medical care of athletes has resulted in governmental recognition and regulation. As with other allied health professions, legislative action has delineated and defined the athletic trainer’s role in providing health care. In addition, state licensure and recognition have provided athletic trainers with an established legal right to work in their chosen profession.

As state licensure laws take effect, certain considerations may need to be examined. First, are the licensure laws uniform in all states? Second, are all athletic trainers eligible for licensure in all states? Third, are there limitations in the scope of practice for athletic trainers? Athletic trainers pursuing positions in states other than their own need to have a basic knowledge of the various state regulations. Therefore, the purpose of this study was to evaluate the regulations concerning athletic training in those states that require licensure, registration, or state certification.

Methodology
I sent letters of inquiry to 20 states that require athletic trainers to be licensed, registered, or state certified. The addresses of the appropriate state departments were obtained from the National Athletic Trainers’ Association (Table 1). Eighteen states responded to the written inquiry within 2 months and one state responded after a telephone call. Additional information was obtained via telephone interview. This resulted in a response rate of 100%. Information received included applications for registration, copies of the individual laws, and personal communication. The survey requested: (1) information about the laws associated with the field of athletic training; (2) an application for state licensure; and (3) any additional information that was pertinent to the practice and role of athletic trainers in that state.

Athletic Training Defined in State Law
In general, the definition of athletic training is uniform throughout the states. In the state of Nebraska, an athletic trainer is “a person who is responsible for the prevention, emergency care, first aid, treatment, and rehabilitation of athletic injuries to athletes under his or her care.” The Nebraska law is similar to laws in many other states. Most states include expressed statements requiring physician supervision and the explicit permission to use therapeutic modalities such as ultrasound and electrical stimulation.

The NATA certification examination of athletic trainers is recognized by all of the states except Texas, which does not accept it as a means to be licensed in Texas. New Mexico requires the NATA’s standards of practice and its established competencies as part of its athletic training licensing requirements. Missouri uses the NATA Code of Ethics.

Location of Employment
Many of the early licensure laws restrict the practice of athletic trainers to educational institutions and amateur professional athletic organizations. The recent state licensure laws permit employment in sports medicine clinics. Many job opportunities are available for athletic trainers in physician’s or commercial sports medicine clinics. The more recent state licensure laws permit employment at these sites. Ohio and Delaware expressly permit the athletic trainer to work in a private clinical setting. According to a June 1991 letter from Myron Cullen, LAT, ATC (President of the North Dakota Athletic Trainers’ Association), North Dakota also allows athletic trainers to be employed in a clinic. Its laws express who can be treated rather than where. More recently, Georgia and Kentucky have amended their laws to permit clinical employment for the athletic trainer. Delaware requires that athletic trainers in the clinical situation work under “the direct, on-site supervision of a physical therapist” with a supervision ratio of two athletic trainers and/or physical therapy assistants for each physical therapist. Ohio also places the athletic trainer under the direct supervision of a physical therapist.

Supervision
Athletic trainers, as defined by many state laws, must work under the direct supervision of a physician who is licensed or accepted in that particular state. This requirement varies in degree according to the state. South Dakota and New Mexico require that the physician’s standing...
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orders be filed with their state board. The licensure application in Missouri (17) requires the submission of a physician’s protocol prior to licensing. New Mexico (24) further guarantees compliance of physician supervision by mandating documentation of all standing orders, prescriptions, and athletic case records. Massachusetts (34) calls for a physician to regularly review an athletic trainer’s medical files. Connecticut (15) requires that the athletic trainer treat athletes referred from a practitioner of the “healing arts.” Delaware (33) provides for a limited direct access, stating that “all treatments for injuries require a physician’s referral, except for minor sprains, strains, and contusions.” South Carolina (1) requires athletic trainers to work under the supervision and consent of the team physician.

In each of the responding states, supervision and referral can come from allopathic (MD) and osteopathic (DO) physicians. Massachusetts (34) and Ohio (25) expressly permit referrals from dentists. Connecticut (15) and Ohio (26) allow referrals from chiropractors. Ohio (26) allows athletic trainers to accept referrals from a physical therapist, while Connecticut (15) permits referrals from naturopaths.

**Scope of Practice**

Athletic training legislation often defines the range of duties of athletic trainers. One area of care is the right of the athletic trainer to use therapeutic modalities other than heat and cold. In general, the use of electrical modalities is permitted according to the states that responded to the survey. In the June 1991 letter from Myron Cullen, LAT, ATC, he stated that North Dakota also allows the use of some mobilization techniques when prescribed by a physician. Pennsylvania (3) restricts the use of modalities, including heat and cold, to athletic trainers who possess Class A state certification/licensure. Those with a Class B certification are restricted to using only heat and cold. According to a June 1991 letter from Katherine Carroll (Assistant Director, Department of Law and Public Safety, The Division of Consumer Affairs, New Jersey Board of Medical Examiners), New Jersey

<table>
<thead>
<tr>
<th>State</th>
<th>Board/Office</th>
<th>Address</th>
<th>City, State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delaware</td>
<td>Board of Athletic Trainers</td>
<td>O'Neal Building, PO Box 1401</td>
<td>Dover, DE 19903</td>
</tr>
<tr>
<td>Georgia</td>
<td>GA Board of Athletic Trainers</td>
<td>166 Pryor Street, SW</td>
<td>Atlanta, GA 30303</td>
</tr>
<tr>
<td>Idaho</td>
<td>ID State Board of Medicine</td>
<td>208 North 8th Street, #202 State House</td>
<td>Boise, ID 83720</td>
</tr>
<tr>
<td>Illinois</td>
<td>Dept of Professional Examiners</td>
<td>302 W Washington, Third floor</td>
<td>Springfield, IL 62786</td>
</tr>
<tr>
<td>Kentucky</td>
<td>KY Board of Medical Licensure</td>
<td>Mall Office Center, 400 Sherburn Lane, Suite 222</td>
<td>Louisville, KY 40207</td>
</tr>
<tr>
<td>Louisiana</td>
<td>LA State Board of Medical Examiners</td>
<td>830 Union Street, Suite 100</td>
<td>New Orleans, LA 70112</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>Board of Allied Professions</td>
<td>State Office Building, 15th floor, 100 Cambridge Street</td>
<td>Boston, MA 02202</td>
</tr>
<tr>
<td>Missouri</td>
<td>MO State Board for the Healing Arts</td>
<td>PO Box 4, Jefferson City, MO 65102</td>
<td></td>
</tr>
<tr>
<td>Nebraska</td>
<td>State Bureau of Examining Boards</td>
<td>PO Box 95007, Lincoln, NE 68509</td>
<td></td>
</tr>
<tr>
<td>New Jersey</td>
<td>Board of Medical Examiners</td>
<td>28 West State Street</td>
<td>Trenton, NJ 08608</td>
</tr>
<tr>
<td>New Mexico</td>
<td>Dept of Regulation/Athletic Trainers</td>
<td>PO Box 25101, Sante Fe, NM 87540</td>
<td></td>
</tr>
<tr>
<td>North Dakota</td>
<td>Joe Kroeber, ATC</td>
<td>1210 7th Avenue, SE</td>
<td>Jamestown High School, Jamestown, ND 58401</td>
</tr>
<tr>
<td>Ohio</td>
<td>Rachael Mallory</td>
<td>OH Board of Athletic Training, 77 S High Street, 16th floor</td>
<td>Columbus, OH 43266</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>OK State Board of Medical Examiners</td>
<td>PO Box 18256, Oklahoma City, OK 73154</td>
<td></td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>Bureau of Professional &amp; Occupational Affairs</td>
<td>PO Box 2649, Harrisburg, PA 17105</td>
<td></td>
</tr>
<tr>
<td>Rhode Island</td>
<td>RI Dept of Health Professional Regulations</td>
<td>75 Davis Street, Room 104</td>
<td>Providence, RI 02908</td>
</tr>
<tr>
<td>South Carolina</td>
<td>Board of Medical Examiners</td>
<td>2600 Bull Street</td>
<td>Columbia, SC 29201</td>
</tr>
<tr>
<td>South Dakota</td>
<td>SD Board of Medical Examiners</td>
<td>1323 S Minnesota Avenue</td>
<td>Sioux Falls, SD 57005</td>
</tr>
<tr>
<td>Tennessee</td>
<td>Board of Medical Examiners</td>
<td>State Dept of Health</td>
<td>Ben Allen Road, Nashville, TN 37216</td>
</tr>
<tr>
<td>Texas</td>
<td>TX Dept of Health</td>
<td>Bureau of Licensing and Certification</td>
<td>State Board of Athletic Trainers</td>
</tr>
</tbody>
</table>

*Table 1.—Departmental Addresses of States that Require Certification, Licensure, or Registration for Athletic Trainers (Source: NATA, Stemmons Drive, Dallas, TX)*
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June 3-7 University of San Diego, San Diego, California
June 3-7 University of Utah, Salt Lake City, Utah
June 10-14 Puerto Rico Olympic Training Center, Salinas, Puerto Rico (This course will be conducted in Spanish.)
June 24-28 Colorado College, Colorado Springs, Colorado
June 24-28 University of Connecticut, Storrs, Connecticut
July 8-12 University of Louisville, Louisville, Kentucky
July 9-12 University of Alberta, Edmonton, Alberta, Canada
July 22-26 California State University, Chico, California
August 5-9 National Sport and Fitness Center, Indianapolis, Indiana
August 5-9 SUNY-Cortland, Cortland, New York
does not regulate the use of therapeutic modalities, although such legislation has been proposed.

A common trait in athletic training legislation is the restriction of care to athletes. As a result, the stated legal definition of "athlete" becomes significant. Idaho (9) defines an athlete as "a person who is associated with and/or is training for an individual or a team competitive activity that is sponsored by an educational institution, amateur or professional group, or other recognized organization." Missouri (17) recognizes organization." Missouri (17) permits the care of recreational athletes in its licensure laws. Nebraska (20) does not define athlete, but does define athletic injuries as "those injuries that are incurred by individuals through participation in sports or recreation." Care for nonathletes seems to be limited; for example, Delaware's law (36) states that it "...shall be limited to first aid." The term "athlete" does provide some controversy in dealing with other professions. Presently, disagreements exist at the national organizational levels of athletic trainers and physical therapists (7). This disagreement may result in the athletic trainer's scope of practice being expanded or reduced as state laws and compromises begin to reflect the outcome.

Application Procedures

Application requirements for state licensure vary from state to state. In each of the 20 states, an application and fee are required. The applications request information about academic background, present certifications and licensure, and personal history. Most states require the passage of an examination for licensure, unless an arrangement or "grandfather clause" has been made for those individuals who have been practicing as athletic trainers prior to the enactment of the legislation (1,3,5,9,11,13,16,17,24,26,27,29,32,33). An exception may include South Carolina (1), which permits state certification to those who "have met the athletic training curriculum requirements of a college or university and give proof by means of a certified transcript." Most states accept the successful completion of the NATA examination as a basis for obtaining licensure (Table 2). Pennsylvania (3) requires that Class A applicants pass the NATA examination given after 1984, while Class B applicants do not have this restriction. Tennessee (11) requires its applicants to pass a jurisprudence examination conducted by the State Board of Medical Examiners in addition to the NATA exam. Texas (32) is the only state that does not accept the NATA examination and has its own exam. Louisiana (14) accepts the NATA examination, but requires only a 60% score for passing. In a November 1991 telephone interview, Diane Hansmeyer (Associate Director, Bureau of Examining Boards, Nebraska Department of Health) stated that Nebraska offers the NATA exam as the state examination, having contracted directly with the same testing service used by the NATA.

As expected, all states require the completion of a bachelor's degree from an accredited four-year institution. In addition, certain states require further academic and clinical experiences. In general, graduates of NATA-approved programs satisfy the standards of most states (Table 2). Applicants from non-NATA-approved programs may obtain licensure by graduating from a program that is equivalent to an NATA program or by taking additional courses. These courses usually must include: a basic and an advanced athletic training course, anatomy and physiology, exercise physiology, kinesiology, nutrition, psychology, first aid, and cardiopulmonary resuscitation (Table 3). As with Massachusetts (34) and Texas (32), a temporary license may be obtained to allow a later fulfillment of deficiencies, including the successful completion of the necessary examination.

The coursework required in Pennsylvania (3) varies according to the level of state certification desired. Applicants for Class A certification (which permits the use of electrical therapeutic modalities) must complete 45 hours of classroom instruction in both therapeutic exercise and therapeutic modalities (3). Additionally, Class A applicants must complete 30 hours of laboratory instruction in both therapeutic exercise and therapeutic modalities, and pass an NATA exam that was offered after 1984 (3).

<table>
<thead>
<tr>
<th>A - NATA-certified</th>
<th>B - NATA-certified from accredited program</th>
<th>C - NATA-certified and additional coursework (from non-approved programs)</th>
<th>D - NATA-certified and additional coursework (from approved programs)</th>
<th>E - Licensed by another state</th>
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(1) Jurisprudence exam is required as well.
(2) Will be provided Class B certification only.
(3) Additional coursework is necessary for Class A (see text).
(4) Texas requires their own exam in lieu of the NATA exam.
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Therapeutic Exercise  IL, MA, MO, OH, RI, SD
Personal/School Health  IL, KY, MA, MO, OH, RI, SD, TX
Basic Athletic Training  IL, KY, MA, MO, OH, RI, SD, TX
Advanced Athletic Training  KY, OH, RI, TN, TX
Therapeutic Modalities  IL, MA, MO, SD, TN
Physical Evaluations  MA, MO, SD
Instructional Methods  SD
Growth and Development  MA
Advanced Physical Education  MA

Note: Basic and advanced athletic training classes may include topics listed as separate courses in other states.

Several of the states permit reciprocity or endorse the applicants if they hold a license from another state. In lieu of previous licensure, many states will endorse those in possession of NATA certification (Table 2). Texas (32) and Idaho (9) require all of their applicants to complete the normal processing procedures, including the examination. Pennsylvania (3) will endorse applicants with an out-of-state license, but will provide only a Class B state certification. Exceptions to reciprocity or endorsement by other states occur if the applicant originates from a state that will not endorse or provide reciprocity to an out-of-state applicant.

Visiting Other States
Some states make provisions for athletic trainers who travel with their teams from one state to another. Massachusetts (34) permits the nonresident, nonlicensed athletic trainer to work 2 days in a calendar year, and only in association with a Massachusetts-licensed athletic trainer, unless the nonresident possesses a valid out-of-state license. Louisiana allows an athletic trainer to work without licensure if the professional performs the activities of an athletic trainer while employed in an educational institution or athletic organization domiciled in another state, and if accompanying and attending athletes of an educational institution or athletic organization domiciled in another state during or in connection with an athletic contest conducted in Louisiana (14).

As of 1989, New Jersey (23) limits nonregistered athletic trainers to 90 days of service as an athletic trainer within a calendar year while traveling with their teams. Ohio (25) permits nonresident athletic trainers to serve up to 180 days in that state without applying for Ohio licensure. Idaho (9) permits 60 days of coverage, while Missouri (17) allows visiting athletic trainers to care for their teams while in Missouri. Many states do not have laws that address the issue of nonresident athletic trainers performing athletic training services while traveling with their teams.

Discussion
A consideration in athletic training is the constantly changing legislation regarding the profession. The employment of an athletic trainer in the clinic is questionable in some states, and, in response, several states are amending laws to address this controversy. According to a letter from R. Burke, ATC, in May 1991, Massachusetts is presently examining its state laws with the purpose of amending them. Mississippi (2) recently announced legislation to regulate athletic trainers, beginning in July 1991. The governor of Colorado recently signed legislation exempting athletic trainers from the Medical Practice Act, while New Hampshire and New York have similar bills being considered (18).

The passage of licensure laws has provided a legal niche for the practice of athletic training, and the athletic trainer needs to be aware of legislation in her or his intended state of employment. The laws
have delineated the roles and the rights associated with the profession. In the heavily congested and sometimes contested field of health care, laws protecting our health profession may prove to be very helpful to all of us. At the same time, athletic trainers need to be careful that laws do not restrict them from practicing in the allied health care field that traditionally belongs to them.

Acknowledgements
A special thanks to those who responded to my requests and inquiries. Without your help and interest, my efforts would have been fruitless.

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Alternative Methods for Football Helmet Face Mask Removal

Leah A. Putman, MA, ATC

Removing the football helmet face mask is the first step in providing emergency care for an athlete who requires rescue breathing or cardiopulmonary resuscitation (1,3,7,8). The literature and current practice in athletic training suggest using bolt cutters or a sharp instrument to remove the face mask and/or the face mask hardware (5,8,9). Considering the changes in the design of face masks and face mask attachments, a screwdriver or wire cutters provides a reasonable alternative for removing face masks.

The use of bolt cutters originated when the face mask itself was screwed to the helmet. The only method of removing the face mask, other than unscrewing it, was to cut the mask at several points. Now, the face mask is attached to the helmet with plastic clips. Several sports medicine practitioners have advocated using a sharp instrument to cut the plastic clips (5,8-10).

Cutting the plastic clips can be hazardous, because if the sharp instrument slips, it could cut the athletic trainer or the injured athlete. Even in practice situations, it is difficult to cut the clips without causing the instrument to slip. Also, it is difficult to cut the clips when they have aged, because the plastic becomes harder and less pliable as a result of exposure to the weather, sweat, and dirt.

Alternative Methods

The plastic clips that attach the face mask to the helmet are screwed to the helmet. These clips, located near the helmet earholes, can be unscrewed or cut and then removed to allow the face mask to be swung away from the face. This provides access for airway management for the injured athlete (7).

A regular or rechargeable electric screwdriver with the appropriate tip can usually be used to unscrew the metal hardware that attaches the plastic clips to the helmet. Sometimes, however, the metal hardware (the screw and the bolt on the inside of the helmet) rust together. When this occurs, unscrewing simply turns the inside bolt without loosening the screw.

A second method is to cut the plastic clips with a pair of electrician’s wire cutters. The wire cutters then can be used to pull the clips out of the way, allowing the face mask to be swung away from the athlete’s face.

It is advantageous to use either the screwdriver or wire cutters because a minimum of instruction time is necessary to learn and practice the task, and the chance of cutting the athletic trainer or the injured athlete is reduced. Both of these tools are readily available at a low cost, and both tools will fit into an athletic trainer’s pocket or side pack along with a pair of scissors.

Procedure

1. Correctly position the athlete on his or her back.
2. One athletic trainer must stabilize the athlete’s head and neck by securing the helmet. To do this, place the index fingers or thumbs in the helmet earholes and hold tightly (Fig 1).
3. With the head and neck stabilized, another athletic trainer uses the screwdriver or wire cutters to free the face mask from the attachments next to the helmet earholes (Fig 2, Fig 3).
4. Free the face mask completely from its attachments to the helmet.
5. Swing the face mask away from the athlete’s face for airway management (Fig 4).

Conclusion

Regardless of the method chosen for face mask removal in an emergency, the following guidelines must be emphasized:
1. Acknowledge that potentially serious injuries can occur and make a plan to deal with serious injury. This must include securing the proper personnel and equipment to handle the injury and to...
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Fig 2.—Use the screwdriver to remove the plastic clips.

Fig 3.—Use the wire cutters to cut the plastic clips.

Fig 4.—Swing the face mask away from the athlete's face for airway management.

Acknowledgements
Appreciation is expressed to Mike O'Larey, ATC, and Louis Sandoval for their time and assistance.

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prevent further injury to the athlete (4).
2. Become familiar with all types of helmets that your teams use and learn how face masks are attached to the various helmets (2). Emergency procedures demand knowledge of the equipment.
3. The methods described here to remove the plastic clips should be understood and practiced, along with stabilization and transportation of the athlete.
4. Even if you choose to use the newer methods of face mask removal, bolt cutters need to be used on older single and double bar face masks (9), and should be readily available for sideline use (6,8).
A Look at the Components and Effectiveness of Sports Drinks

ABSTRACT: The confusion about sports drinks is lessened if the types are understood. Types include: fluid replacers, carbohydrate loaders, and nutrient supplements. The athletic activity and the timing of the consumption of the drink need to complement the type of drink. Fluid replacement is a must before, during, and after activity to maintain heart rate and body temperature. Whether water or a sports drink is consumed is the athlete’s choice. The carbohydrate concentration of a fluid-replacing drink should not exceed 10%, which is comparable to the gastric emptying characteristics of water. Glucose, sucrose, and glucose polymers are all well tolerated by athletes during activity, although fructose in high concentrations may not be. Electrolytes are present in drinks to enhance absorption; high levels usually are not needed, except in certain populations.

An important aspect of athletic activity is proper hydration. Fluid loss occurs in any climate, but is more detrimental in areas with high temperatures and humidity. A weight loss of greater than 2% resulting from dehydration can fatigue the athlete, cause a loss of concentration, increase heart rate, and lead to circulatory collapse (3,10,11,13).

One role of an athletic trainer is to ensure that athletes are properly hydrated throughout activity. Water is the most common fluid replacer. Some athletic trainers are fortunate enough to have the resources to provide sports drinks to their athletes. The athletes, therefore, have the opportunity to choose between water and sports drinks. The “ideal” sports drink should provide: (1) a rapid gastric emptying rate; (2) a body fluid balance; (3) minerals that are typically lost through sweat; and (4) an adequate carbohydrate source to aid in energy supply and performance (10,13).

Because an abundance of sports drinks are on the market today, athletes as well as athletic trainers are being bombarded with new products claiming superiority over existing ones. This has caused a great deal of confusion, leaving it unclear about which type of drink to use and when.

The purpose of this article is to help lessen the confusion about sports drinks. As the athletic trainer considers the use of a sports drink, he or she should examine the activity of the athlete. Also, the drink should be analyzed for its hydration properties, its gastric emptying and absorption rates through the small intestine, and the types of carbohydrates and electrolytes present in the drink.

Types of Sports Drinks

There are three types of sports drinks on today’s market—fluid replacers, carbohydrate loaders, and nutrient supplements. Each is designed for a specific use and should not be used for other purposes.

Fluid Replacing Drinks

Fluid replacing drinks include Exceed Fluid Replacement Drink, Gatorade, 10-K, Quickick, Max, and Carboplex II (1,4,7). These drinks are absorbed as quickly as water and typically are used in activities lasting less than 2 hours. Fluid replacing drinks can be used in place of water and should be consumed before, during, and after physical activity. Many of the fluid replacers contain glucose polymers that provide a faster gastric emptying rate and an energy source (10). Therefore, some of these drinks fit into two categories—fluid replacing drinks and carbohydrate loading drinks.

Carbohydrate Loading Drinks

The second category is the carbohydrate loading drinks, which includes Shaklee Performance Maximum Endurance Sports Drink, Gatorlode, Exceed High Carbohydrate Source, and Carboplex (1,4,7). The difference between fluid replacing and carbohydrate loading drinks is that the carbohydrate loaders produce more muscle glycogen for greater endurance. These drinks should be used before and after ultraendurance events to increase muscle glycogen resynthesis after exercise (13).

Nutrient Supplement Drinks

Finally, there are the nutrient supplement drinks like Gatorpro, Exceed Sports Nutrition Supplement, and Ultra Energy (1,4,7). These supplements are fortified with vitamins and minerals and they help athletes to maintain a balanced diet. Athletes who need to lose weight can use these drinks to replace some of their food intake that is high in fat and calories. Conversely, such a drink may be taken with meals to increase caloric content to gain weight.

Gastric Emptying

Gastric emptying is the process by which the contents of the stomach are emptied into the small intestine. The two main factors that stimulate gastric emptying are: (1) nerve impulses that act in response to stomach distension; and (2) the action of gastrin, a hormone released from the pyloric mucosa in the presence of a meal or a volume of fluid.
of partially digested proteins (15). The emptying rate is also influenced by the caloric content, volume, osmolality, temperature, and pH of the fluid in the stomach; diurnal variation; metabolic state; and ambient temperature (2,11,12).

Foods rich in carbohydrates are quickly digested and leave the stomach most rapidly. Proteins take longer. Fats are digested and moved to the small intestine slowly (15). Foods and beverages similar in caloric content empty from the stomach at similar rates (2). However, excessive caloric intakes will delay gastric emptying (12). While moderate exercise (<70% VO2 max) does not affect gastric emptying rates, intense exercise inhibits emptying by shunting blood flow away from the gastrointestinal tract to the working muscles (12,13).

Drinks containing more than a 2.5% carbohydrate content have been shown to delay gastric emptying (2,10). However, one study conducted by Murray (12) contradicts this statement. He found that when fluids were consumed at regular intervals throughout prolonged exercise (greater than two hours) postexercise aspiration revealed that solutions containing up to 10% carbohydrates empty at rates similar to water. This is supported by the fact that glucose and sodium stimulate fluid absorption in the small intestine (2,11,12).

Solutions contained in sports drinks are classified as penetrating or non-penetrating. Nonpenetrating solutes set up an osmotic gradient that does not allow water to enter the osmoreceptor in the cell; therefore, these shrunk vesicles slow gastric emptying. The smaller the receptor, the slower the emptying of the stomach. Large amounts of hypertonic solutions keep the osmoreceptors shrunken and delay gastric emptying. Rehydration drinks with carbohydrates are examples of non-penetrating solutes. Consuming these types of drinks results in a relatively constant stomach volume maintained by gastric secretion and some emptying into the small intestine (3).

Penetrating solutes enter the vesicle, reverse the osmotic gradient, and enlarge the vesicle. The enlarged vesicle decreases the inhibitory signal while increasing gastric emptying. Isotonic sodium chloride is an example of a penetrating solute (13,14).

In a study by Foster et al (6), a 5% polymerized glucose solution was emptied from the stomach faster than a 5% free glucose solution. They found that 69% more fluid and 33% more carbohydrate were delivered to the small intestine after thirty minutes of exercise with the 5% polymerized glucose than with the free glucose solution (6). In comparing 7% and 10% polymerized glucose solutions, they found that the more dilute the solution, the faster the gastric emptying.

In selecting a sports drink, the certified athletic trainer should match the gastric emptying characteristics of the sports drink with the type of activity of the athlete. For example, an ultramarathon athlete may benefit from a drink containing glucose polymers. Glucose polymers are absorbed as quickly as water to prevent dehydration, but they also provide enough carbohydrates to delay fatigue. Other athletes, such as football and basketball players, would benefit more from using fluid replacing drinks because they sweat heavily.

Types of Carbohydrates

As stated earlier, the type of carbohydrate has no major influence on the rate of gastric emptying, provided that the concentration of carbohydrate is low (13). Simple carbohydrates, such as sucrose, glucose, fructose, and/or glucose polymers (also known as malto-dextrins), are added to the sports drinks on the market. Each are included according to the main purpose of the drink, i.e., nutrient supplementation, carbohydrate loading, or fluid replacement.

Glucose polymers are chains of glucose molecules that are shorter than starches, but longer than simple sugars (17). Polymers are more beneficial to the athlete than simple carbohydrates because they pass through the stomach more rapidly (13). Simple carbohydrates and glucose supply energy and maintain fluid balance in the range of 5 to 10% carbohydrate concentration (1,12). Glucose polymers are used in drinks to increase the carbohydrate content up to 15%, which renders them more palatable, and to increase the gastric emptying rate. At the same time, they minimize the osmolality, because they decrease the effect on osmoreceptors while increasing gastric emptying (13).

Glucose, maltodextrin, and sucrose all stimulate fluid absorption in the small intestine. These solutes, when consumed during exercise, have similar effects on cardiovascular thermoregulatory responses and performance (2). Fructose is absorbed more slowly than other carbohydrates and does not stimulate as much absorption of fluid (2). Fructose is not associated with performance improvement, possibly because it cannot be metabolized and released rapidly enough by the liver to provide adequate amounts of glucose to the working muscles (2). Fructose is not associated with rebound hypoglycemia, but does support hepatic and tissue glycogen resynthesis to a greater degree than does glucose. Muscle glycogen is spared after submaximal exercise with the intake of fructose (13). Gastrointestinal distress and diarrhea are common side effects of drinking solutions containing fructose during exercise, especially at 10% or greater concentrations (1).

Fructose, however, in high concentrations would not be beneficial in fluid replacing drinks because of the slow absorption rate. Carbohydrate loading drinks containing fructose, used days prior to an event, would give the body time to produce more glycogen.

As with the gastric emptying rate of a sports drink, the carbohydrate present in a drink should be matched to the specific use of the drink. Glucose polymers, because of their unique properties, are used as well as glucose and sucrose in both carbohydrate loading and fluid replacing drinks.

Electrolytes

Electrolyte requirements for any individual can be met by consuming a balanced diet. However, fluid and electrolyte imbalances may occur in certain circumstances, such as when individuals are on sodium-restricted diets or in the early stages of acclimation to a hot environment. In addition, imbalances may occur during prolonged, repeated exposure to exercise and heat, and during exercise lasting several hours (2,12). Among the important electrolytes are sodium, chloride, potassium, magnesium, and calcium, which are often included in glucose-containing electrolyte drinks.

Sodium helps maintain proper body fluid volume. Small amounts of sodium improve water and glucose absorption in the body. Glucose-electrolyte solutions maintain body fluid balance better than glucose drinks alone (2). Sodium also plays an important role in muscle contraction and in the conduction of nerve impulses. A slight deficiency of sodium may impair performance, causing nausea, vomiting, headache, loss of appetite, muscular weakness, and leg and abdominal cramps (17).

One common electrolyte imbalance seen in ultraendurance athletes is
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hyponatremia or water intoxication. As a result of an excess of sodium lost through sweat, a sodium deficit occurs. This condition could be further complicated by the ingestion of water or other low-sodium beverages during exercise. A sodium loss of 500 to 1000 mg per pound of sweat can be life threatening (1,2). For individuals with the potential for developing hyponatremia, the ingestion of sodium while exercising will help maintain and restore the plasma volume during exercise and recovery. Beverages containing sodium help retain water in the extracellular space while promoting thirst. Drinking plain water tends to decrease plasma osmolality, leading to a decreased desire to continue drinking. Therefore, plasma volume is not adequately restored, because fluid intake is insufficient.

Ingesting sodium before exercising, an activity that many coaches suggest, is not recommended for all athletes. Sweat contains more water and less sodium and potassium than does blood plasma. Exercise and heat exposure often cause an increased concentration of electrolytes in the plasma. Because the concentration increases, added intakes may disturb normal electrical activity in the heart and muscles, with possible severe consequences such as heat illnesses and cardiac arrest (17).

The role of chloride in athletic activity is similar to that of sodium in regulating electrical potentials across cell membranes. The loss of chloride in sweat is proportional to the loss of sodium (17). Potassium also plays a role in muscle contraction and nerve impulse conduction. In addition, it aids in the storage and transport of glycogen across the cell membrane (17).

Magnesium assists in the formation of adenosine triphosphate (ATP) and regulates neuromuscular transmission, muscle contraction, and protein synthesis. Chronic diarrhea and vomiting may lead to a deficiency of magnesium, which is rare, but results in muscle cramps and weakness. Each day, athletes should consume 8 mg/kg of body weight (17). That amount is important for normal recovery after activity and helps prevent muscle cramps.

Calcium has a role in the formation of bones and teeth, muscular contractions, transmission of nerve impulses, blood clotting, and glycogen metabolism. An excess of calcium in the body leads to an abnormal heart rate and muscular weakness. A deficiency leads to muscle cramps and impaired physical performance by disrupting normal neuromuscular functioning (17).

A minimal amount of these electrolytes are lost through sweat. A well-balanced diet sufficient in these elements, prior to activity, should keep the body fluid balanced to avoid detrimental losses. The recovery meal also should be adequate in minerals to replenish the losses from the activity. Again, these elements are included in sports drinks to improve the absorption rate and fluid balance in the body.

**Performance Improvement**

The idea of performance improvement through the use of sports drinks is a very controversial topic. Some studies conducted have found improvements (2,9,10,13) and others have not (5,17). Mechanisms for improvement are unclear. Carbohydrate feeding during exercise may spare muscle and liver glycogen. When muscle glycogen stores become depleted during exercise, carbohydrate feedings may maintain the blood glucose levels, allowing carbohydrate use and energy production to continue at high rates (2).

Performance improvement is associated with the consumption of at least 25 to 30 g of carbohydrate each hour. Fluids with a 6% carbohydrate solution can achieve this. The American College of Sports Medicine recommends 4 to 8 oz of fluid every 15 to 20 minutes during exercise (2).

Work by Wahren et al demonstrated that ingestion of a hypertonic 30% carbohydrate solution resulted in an increased glucose uptake and oxidation in the working muscle, decreased fat mobilization, increased gluconeogenesis, and a greater glucose release from the liver. This would result in using the carbohydrate too fast and from the wrong sources.

Work by Ivy et al (8) found that while carbohydrate supplementation did not improve overall performance significantly, the onset of fatigue was delayed during the last 30 minutes of an exercise bout. With carbohydrate supplementation, the exercise performed during the last 10 minutes was of greater intensity than that performed in the first 10 minutes.

If a high carbohydrate diet precedes athletic activity, the type of sports drink ingested has no effect on performance improvement. If glycogen stores are low prior to activity, the carbohydrate consumed in a drink during activity will spare muscle glycogen. During prolonged exercise (>2 hours), carbohydrate loading drinks can help maintain glucose levels.

**Acknowledgements**

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**References**

ABSTRACT: The purpose of this paper is to demonstrate a treatment program that may permit a student-athlete who has a mandible fracture to continue participation in a sport without further jeopardizing his or her health. This article is based on an actual case in which a student-athlete sustained a mandible fracture during an intercollegiate basketball game. Within 24 hours, the injured athlete resumed basketball practice. Three days following the injury, he was permitted to compete in a game. In addition to recommendations regarding acute care, we discuss protective equipment, follow-up guidelines, and nutritional considerations. These guidelines may assist the sports medicine team in determining when an athlete with a mandible fracture can return to competitive and contact sports.

Although the occurrence of major facial fractures in athletes is unusual in athletic competition, fractures to the mandible are the most common (5). For the athletic trainer, this injury may pose uncertainties regarding the athlete’s continued participation in athletics and the daily management of the injury. This paper describes a case in which the preventive techniques employed by an athletic trainer and the daily management of the injury by a physician permitted a student-athlete with a mandible fracture to continue athletic competition during an intercollegiate basketball season. Although the results in this particular case were very favorable, it should be noted that the protocol discussed may not be applicable or available in all situations. Extreme care, daily supervision by a physician, and a well-rehearsed emergency plan must be in place to ensure reasonable medical safeguards for the athlete.

Case Report

During the first half of an intercollegiate basketball game, a 20-year-old male athlete was driving to the basket for a lay-up. He was a highly skilled and versatile athlete who had no prior history of any injuries to the mandible. After a reverse spin move, when the player had both arms extended toward the basket, an opposing team member inadvertently cut underneath him. The player fell directly on his chin, came to rest in a supine position, and became unconscious.

An initial evaluation revealed a 4 cm chin laceration and a definite malocclusion. The athlete soon regained consciousness and was able to communicate verbally. After the player was evaluated for cervical spine injuries, he was removed from the floor. The team physicians sutured the player’s laceration while he was in the athletic training room. Then, the athlete was transported to a medical facility.

Radiographs confirmed the presence of a parasymphal fracture of the mandible (Fig 1). The treatment plan chosen was a closed reduction with intraoral maxillomandibular fixation and arch bars. Open reduction and rigid internal fixation may have decreased the period of maxillomandibular fixation; but, in this case, it was deemed unnecessary for optimal long-term results (8).

A nutrition program to help facilitate caloric intake was immediately implemented. For an active male athlete (6'3", 195 lbs), the recommended caloric intake is between 3500 to 5000 calories per day. An average patient can expect to lose 10 to 15 pounds of body weight when recovering from such an injury. Because of the nature of the injury and the normal level of athletic competition of the athlete, an additional 750 to 2000 calories were recommended to decrease the possibility of nutritional deficiencies during the recovery period (7).

Nutritional supplements such as Ensure Plus, Gatorade, milk shakes, soups, and carbonated beverages were provided, and the athlete was encouraged to consume them, even if not desired. Experimentation by the athlete with blended...
foods quickly became a normal routine. Similar dietary supplements were made available for the athlete at all team meals and for pre-game meals.

**Preventive Considerations**

Less than 24 hours after surgery, when he felt capable, the athlete was permitted to shoot some free throws. The surgeon, athletic trainer, and coaching staff then met with the athlete, who expressed a desire to attempt a return to full participation.

At this time, the group discussed the potential complications that might arise from continuing competitive sports, the problems relating to the protection of the repaired soft tissue injuries, and the control of pain without using narcotics. Other areas that were discussed included: (1) chronic increased oxygen debt secondary to the maxillomandibular fixation; (2) acute oxygen debt secondary to oral airway compromise involving the maxillomandibular fixation; and (3) possible future nasal fracture. Because the athlete still expressed a desire to compete, a safe program of rehabilitation that included competition was developed.

During practice, the use of oxygen helped to alleviate the subjective oxygen debt. In the event that serious nasal compromise did occur, an emergency kit that included wire cutters, wire twisters, nasopharyngeal airways, and positive pressure oxygen was available. In this particular case, an oral and maxillofacial surgeon was present for all games and practice sessions. When a surgeon is not available to coordinate emergency procedures, the athletic training staff should be educated to watch for airway compromise. The observation of accessory respiratory efforts such as suprasternal notch retraction and chin and upper extremity elevation are indications of a compromised airway. In addition, each staff member should be trained in the removal of maxillomandibular fixation and in intubation in case the nasal airway is compromised. In this case, the athlete rapidly adapted physiologically to the airway compromise created by the maxillomandibular fixation.

Three days after injury the athlete returned to competitive basketball. Oxygen was used infrequently (ie, less than once per game), even though the athlete averaged playing 31.5 minutes per contest for the thirteen games following the injury. During the first 26 games of the regular season, his average playing time had been 26.8 minutes per contest.

A hockey helmet (Fig 2) mounted with a football face mask was worn during practices. A plexiglass eye shield was mounted to the face mask to protect opponents from catching their fingers in the face mask area. Although very effective, such equipment would not be permissible for games, according to intercollegiate basketball rules and regulations.

An orthoplast nasal mask (Johnson & Johnson) was custom fabricated and replaced the hockey helmet for games. Although the orthoplast nasal mask does not provide the protection of a full face mask, the surgeon thought that the possibility of injury was remote and made even less likely because of the protection provided by the nasal mask and the psychological "red flag" that the mask produced for the player, opposing team, and officials.

At 3 1/2 weeks into treatment, a lighter wire maxillomandibular fixation was used and could be more readily removed than the original heavier gauge wire fixation. In addition, the athlete was allowed to choose not to use the orthoplast nasal splint. A transition from wire fixation to a form-fitted mouthpiece was implemented gradually about 4 weeks after surgery. The surgeon and athletic training staff remained in attendance at practices and games in order to provide emergency care. Complications experienced during the six-week recovery period included: a reopening of the chin laceration during the first week of play; pain from occasional blows to the face and/or chin while wearing the mouthpiece with the elastics; and during games, minimal pain experienced while the wire fixation was in place.

**Postoperative Care**

After 4 1/2 weeks, the maxillomandibular fixation was removed, although the arch bars were retained. At this time, range of motion of the mandible was emphasized and the athlete’s nutrition program was normalized. The arch bars were retained to enable elastics and a mouthpiece to be worn during practices. A more stable wire fixation was worn during games.

After recovery from the surgery, the athlete was referred to a dentist for repair of teeth that were chipped during the original injury and to ensure that no other major problems had occurred.

**Discussion**

Compromise of the facial skeleton and associated tissues is occasionally seen in athletic endeavors and is most common in basketball (6). Difficulty in treatment of these injuries can arise at the time of the subjective or objective diagnosis, during definitive treatment, or during long-term postoperative care. Usually, an obvious traumatic incident will precipitate subjective complaints by the athlete and will lead to consultation with the athletic training staff. Occasionally, the athlete will not consult anyone because he or she lacks knowledge regarding the significance of the injury or is concerned about a loss of playing time.

Facial fractures can include any component of the facial skeleton, including the orbits, nose, maxillofacial complex, maxilla, or mandible. Textbooks often describe discreet, definitive injuries such as Le Fort I, II, or III fractures of the mid-face and angle, rami body, or condylar fractures of the mandible (1.3). These descriptions are convenient, but the combinations and permutations of an injury are often unique and must be approached individually from diagnosis to follow-up care.

Soft tissue injuries that are associated with the facial skeleton include any soft tissue enveloping the compromised bones. These soft tissue injuries include skin, lips, oral and nasal mucosal membranes, orbital globes, or central nervous system components (3).

Subjective findings can include, but are not limited to, pain, numbness, and malocclusion.

Objective findings indicative of facial skeletal compromise can include: loss of consciousness; paresthesia or anesthesia of the peripheral sensory branches of the first, second, or third divisions of the trigeminal

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**Fig 2.—Hockey helmet mounted with a plastic face mask**

An orthoplast nasal mask (Johnson & Johnson) was custom fabricated and replaced the hockey helmet for games. Although the orthoplast nasal mask does not provide the protection of a full face mask, the surgeon thought that the possibility of injury was remote and made even less likely because of the protection provided by the nasal mask and the psychological "red flag" that the mask produced for the player, opposing team, and officials.

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nerve (V); facial paralysis secondary to trauma

Once the diagnosis is made, the athlete should be referred to the team physician responsible for care of the injury. At this time, the diagnosis can be confirmed clinically and radiographically, and a definitive treatment plan can be developed.

Care of facial skeletal injuries may include observation, splinting, closed reduction, or open reduction, including rigid or non-rigid fixation.

Indications for open reduction include gross displacement, unresiding pain, severe clinical range of motion limitations, or bilateral ramus/condyle fractures that affect vertical facial height (2,8). Open reduction of condylar fractures should be used with caution in young adults because of the potential of significant remodeling in the joint structure (4). Because of the diverse injuries that may occur, surgical therapy should be individualized for the particular case in order to optimize both short- and long-term results.

Although other treatment plans could have been implemented successfully for this injured basketball player, the treatment used for this particular injury was a practicable option. The athlete returned to practice in less than 24 hours after surgery, played in all games during the entire 6-week postoperative recovery period, and healed in a timely fashion. In similar circumstances, this treatment plan should be considered by the team physician and athletic trainer.

References


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UNCONDITIONAL GUARANTEE
A Survey of Athletic Medicine Outreach Programs in Wisconsin

ABSTRACT: In 1985, Sherman (21) reported a lack of organized and supervised health care for athletes in southern Wisconsin high schools and proposed that outreach athletic trainer services could help fill this gap. In order to determine the extent to which outreach programs are providing athletic training services, in January 1990, I surveyed 30 athletic medicine outreach services in Wisconsin to observe the frequency and scope of care being provided. Twenty-six surveys were returned. Results indicated that: (1) nearly half the high schools in Wisconsin subscribe to an outreach service; (2) outreach visits vary per individual school/service agreement, but average 2.5 visits per week, 2 hours per visit; (3) generally, outreach services furnish medical coverage to community athletic events as well as provide a source of continuing education programs for local coaches and administrators; 4) fees for services vary per contract, with nearly one-third of the respondents operating on a "no fee" volunteer basis; (5) nearly two-thirds of the outreach services emanate from a physical therapy department; and (6) 88% of services employ certified athletic trainers to provide outreach care. Outreach services appear as the mode of choice for providing athletic medicine in Wisconsin. Although some care is better than none, the quality and comprehensiveness of this care requires further investigation.

The need for trained athletic medicine personnel at the high-school level has been well documented in the literature (3,4,13,16,19,21,27). Reasons suggested for the insufficient care provided at this level include lack of interest by the medical community, apathy of the school administration, minimal access because of locality, and budget restraints of school districts (3,13,16,20,27). Care for the acutely injured athlete has continued to fall to the coaching staff, who often are uncomfortable with this responsibility and ill-prepared to render this service (16,17,21,27).

Sherman (21) reported in 1985 that, in Wisconsin, physician coverage of high school athletics was erratic and varied depending upon the size of the school and the particular sport. Only 7.8% of the schools surveyed had contracted for the services of a team physician. Although 62% of the respondents stated that they had a designated training room, only 8.5% actually employed a National Athletic Trainers' Association (NATA) certified athletic trainer. Coaches were responsible for follow-up care to the injured athletes at 45% of the schools, yet only 17% of the schools required their coaches to have a standard first aid certification. Similar results were reported by Redfearn (17) 10 years earlier in Michigan high schools, and again by Culpepper (3) in 1986 in a survey of Alabama high schools. With the identification of these problems, various authors have proposed that certified athletic trainers fill this health care gap (2,8,14,16,19,20).

Several options for acquiring these services have been suggested. These include hiring a full-time staff athletic trainer employed by the district to administer a comprehensive athletic medicine program to all school or district teams, or hiring a teacher/administrator who performs athletic trainer duties on a part-time stipend basis similar to a three-sport head coach (20). The most common method of providing athletic medicine services in Wisconsin is by contracting with an outreach athletic trainer from a health care facility to make regularly scheduled visits to a number of high schools. This study attempts to quantify the range, scope, and disposition of athletic training outreach services in the state of Wisconsin since 1982 when the University of Wisconsin Hospital Sports Medicine Center in Madison initiated the first program (21).

Methods
I composed a survey to ascertain: (1) the number of high schools serviced by outreach programs; (2) how these programs are administered; (3) fees, contracts, and liability problems; (4) what groups of professionals are providing these services; and (5) what level and type of care is being given. No comprehensive source listing current outreach services in Wisconsin could be identified.

I discovered 30 outreach programs providing services in the state through telephone canvassing, referral from both written and personal communication with known sports medicine clinics listed in the Physician and Sportsmedicine Sports Medicine Directory 1987 (23), and personal communication with the president and the state representative of the Wisconsin Athletic Trainers' Association. The qualifying criterion for this study required that the health care clinic, hospital, or practice provide off-site athletic medicine service to at least one high school. I identified and sent surveys to 30 services; 26 (87%) returned completed surveys. Personal communication with non-return groups revealed that one had discontinued operations, and two had not begun outreach service at the time of survey. One service returned an incomplete survey.

Results
Scope of Outreach Services
Of the 482 public and private high schools with interscholastic athletic programs in Wisconsin, at least 221 (45.8%) in January 1990 received some sort of athletic training outreach service. Interestingly, 15 junior high schools, three technical colleges, two four-year colleges, five club sports, and one semi-professional football team also subscribed to outreach services.

Steven J. Nass, PT, ATC, REMT
The number of schools serviced by an individual outreach program varied from 1 to 45 high schools with a mean of 8.2 schools per service. Frequency of outreach visits to each high school varied from “as needed” to daily. These variations existed among outreach services as well as within each service depending on individual agreements with each school. The mean number of visits was 2.5±1.2 per week. The number of hours spent at each high school varied with individual school contracts. Visits varied from 1 hour to 5 hours per day with a mean of 2.0±1.0 hours per visit. Eight services reported that they provide regular practice coverage, but did not clarify if this was for all sports. Twenty outreach services indicated that they also provide medical coverage for other community athletic events including runs, weight lifting meets, Special Olympics, and youth recreational programs.

**Student Athletic Trainer Supervision**

Student athletic trainer involvement with a supervising outreach athletic trainer was minimal. Only eight services reported using high school student athletic trainers, although 11 reported offering that service. Only five (19%) respondents indicated that their clinical site of origin was approved by the NATA for documenting clinical hours towards athletic trainer certification.

**Fees/Contracts**

Eighteen services provided outreach services through written contracts, with a nine- to twelve-month flat fee. These fees varied from $25 to $8,449, depending upon the level and frequency of services provided. One outreach program charged $500 per season while another charged $11 per hour on an “as needed” basis. Nine services reported a “no charge” volunteer basis without written contracts.

**Origination of Outreach Services**

Physical therapy departments appeared to be the most prevalent base of operations for outreach services, with 65.3% originating from a physical therapy private practice, physician-owned physical therapy service, or hospital-based physical therapy department. One reported that the base of operations was a corporate-owned physical therapy service. The remainder emanated directly from a physician’s office or clinic.

**Legal/Liability Issues**

The outreach services were asked whether any legal/liability issues had been raised regarding the provision of care. Nine respondents indicated that issues were raised, most notably involving contract clarifications, and who assumes liability—the individual athletic trainer, the outreach service, or the school. Two respondents expressed a need for the development of an informed consent waiver to be signed by the athlete’s parents in the event that athlete decides to participate in sports activities contrary to medical advice. Two outreach services questioned who should decide which sports events are “high-risk enough” to warrant paying an athletic trainer to provide coverage when school district budgets are restricted.

**Outreach Personnel**

Various combinations of credentialed individuals provided outreach visits, with several services employing a combination of professionals. Certified athletic trainers were reportedly employed by 89% of outreach services, while 22% employed physical therapists, 30% employed dual-credentialed physical therapist/certified athletic trainers, and 19% had physicians providing outreach services. Twenty-five of 26 respondents reported that their outreach personnel had other clinical responsibilities in addition to providing services to schools.

**Additional Services Offered**

Services provided by the outreach services that were surveyed are listed in Table 1. In addition, one service indicated that they provide selected orthotics and braces free of charge to contracted schools. Continuing education courses for coaches, athletic directors, and administrators were provided by 85% of the outreach services, although the survey did not indicate whether this was part of a contractual agreement. In-house team fitness evaluations at some level were provided by 73% of the outreach services, although several indicated that these evaluations were not exclusive to their outreach schools. See Table 2.

**Discussion**

The advent of outreach athletic training programs in the state of Wisconsin has

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**Table 1.—Services Provided by Outreach Services (N=26)**

<table>
<thead>
<tr>
<th>Service</th>
<th>No. Offering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injury/Illness Evaluation</td>
<td>26</td>
</tr>
<tr>
<td>Skinfold Body Composition</td>
<td>18</td>
</tr>
<tr>
<td>Hydrostatic Weighing</td>
<td>2</td>
</tr>
<tr>
<td>Protective Equipment Fitting</td>
<td>17</td>
</tr>
<tr>
<td>Team Strength and Conditioning Advice</td>
<td>25</td>
</tr>
<tr>
<td>Injury Rehabilitation Advice</td>
<td>23</td>
</tr>
<tr>
<td>High School Student Athletic Trainer Program</td>
<td>11</td>
</tr>
<tr>
<td>Athlete Fitness Evaluation</td>
<td>11</td>
</tr>
</tbody>
</table>

**Table 2.—In-House Team Fitness Evaluations (N=26)**

<table>
<thead>
<tr>
<th>Service</th>
<th>No. Offering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength Testing</td>
<td>16</td>
</tr>
<tr>
<td>Isokinetic</td>
<td>16</td>
</tr>
<tr>
<td>Isotonic</td>
<td>6</td>
</tr>
<tr>
<td>Isometric</td>
<td>7</td>
</tr>
<tr>
<td>Flexibility</td>
<td>18</td>
</tr>
<tr>
<td>Body Composition</td>
<td>15</td>
</tr>
<tr>
<td>Aerobic Capacity</td>
<td>3</td>
</tr>
<tr>
<td>Anaerobic Capacity</td>
<td>2</td>
</tr>
<tr>
<td>Nutritional Advice</td>
<td>8</td>
</tr>
<tr>
<td>Other—one each: Medical History, Specific Sports</td>
<td>1</td>
</tr>
<tr>
<td>Counseling, Pre-season Exams, Orthopedic Screening</td>
<td>1</td>
</tr>
</tbody>
</table>
helped to fill the medical care gap described by Sherman (21), yet has fallen short of the NATA goal of an athletic trainer in every high school (14).

Unfortunately, the data from this survey tend to indicate a dollars and cents approach to high school athletic medicine. Outreach services appear to provide only a level and frequency of care commensurate with the particular school’s ability to pay or with an outreach service’s willingness to volunteer their staff’s time. Whether this is adequate or optimal care is questionable and requires further investigation. This is far short of the employment of a full-time athletic trainer or teacher/athletic trainer at a high school.

Prentice and Mishler (14), in their 1986 survey of high school principals, also illustrated some relatively bleak prospects for the future employment of full- or part-time certified athletic trainers in the high school setting, especially if they are not teacher-certified. What is encouraging, however, is that at least 46% of the state high schools are involved with outreach services in the care of their athletes. This indicates that high school coaches and administrators do recognize the need for and the benefits of athletic training services. This conclusion is consistent with data reported by Garrick and Requa (5) in 1981 and Ray (15) in 1987.

Recent NATA injury studies of high school athletes suggest that the rate of injury may be higher during competition, but the majority of injuries are sustained at practice (9,10). The old idea of volunteering your time at a Friday night game is clearly inadequate (27). Outreach services in Wisconsin do appear to be providing a comprehensive service by evaluating injuries sustained during the practice week and by providing rehabilitation advice consistent with appropriate follow-up care. It appears that outreach services in this state will most likely continue to emanate or grow from hospital-based or free-standing physical therapy clinics for several reasons: (1) These clinics are geographically widespread in Wisconsin (26). (2) A greater number of recent NATA-approved athletic training program graduates are being employed in the clinical sector (11). (3) Physical therapy clinics are actively marketing athletic training services to high schools (1,4). A physical therapy clinic as a growth center may be exceptionally expansive in Wisconsin in view of the state legislative action on WISSTAT §448.04(1)(e) (1989), which effectively permits physical therapy practice without prior physician referral. Before that legislation passed, physical therapists could not legally evaluate or treat an injured athlete without the athlete first seeing a physician, nor could a physical therapist “cover” an athletic event. This change in Wisconsin’s Physical Therapy Practice Act allows physical therapists direct access in providing care to athletes during athletic activities (25). Although a role delineation between certified athletic trainers and clinical specialist sports physical therapists was promulgated in a position statement by the Sports Physical Therapy Section of the American Physical Therapy Association (22), the role of the general physical therapist rendering care in the acute athletic situation continues to be debated, as does the ethics of the employment of certified athletic trainers by physical therapists (12).

An increased demand for outreach services is anticipated with the advent of the Wisconsin Interscholastic Athletic Association (WIAA) Wisconsin Wrestling Minimum Weight Project and its goal of establishing a minimum 7% body fat by skinfold measurement of all high school wrestlers. This project also will require an educational component to promote healthy weight loss practices (7). All body composition measurements must be performed by health care professionals who have completed the body composition assessment workshop developed by the WIAA. The WIAA implemented this program with the knowledge that a statewide distribution of athletic medicine outreach programs would provide a knowledgeable and interested pool of skinfold assessor candidates, and these health care professionals were targeted for enrollment in the WIAA workshops. With more than 350 public high schools sponsoring varsity wrestling in the state (24), a considerable amount of pressure will be applied to outreach services to provide health care professionals to assist in fulfilling the requirements of these rule changes.

Although volunteer athletic training service is admirable, it is questionable whether it will be consistent and sustainable without a written contract that binds the health care provider and school. The loss of a volunteer service would likely put many athletic administrators in a budgetary bind, because a customary position might need to be filled by an equally qualified paid, contracted, or staff individual. This situation could be construed as dangerous in the event that medical decisions are returned to the coaches, who have become accustomed to deferring these judgments to an athletic trainer or other health care professional. This is a potentially disturbing phenomenon in our litigious society (15).

Having such a small number of sites for accumulating clinical hours towards NATA certification requirements is unfortunate because more new graduates are being employed each year in clinical/outreach situations (11), and a lack of these sites limits their internship experience opportunities.

Conclusion

In the state of Wisconsin, outreach programs have blossomed since 1982 (21) to the benefit of the high school athlete. Conversely, full-time employment of athletic trainers by school districts in 1990 has decreased from five to four, according to the Wisconsin Athletic Trainers’ Association’s records. One can postulate that outreach services will become more conspicuous in athletic health care, because more school administrators appear to find outreach athletic trainer services the most fiscally and readily available form of athletic health care. These data reinforce Sherman’s (21) 1985 statement that an outreach program: “(1) helps bring direction to the care of the injured high school athlete; (2) improves communication between the local physician and the coaching staff; and (3) provides education for the coaching staff in preventing, treating, and reconditioning sports injuries.” As more high school athletes come in contact with this type of care, I hope that they remember this. In the future, as they become coaches, administrators, parents, and, ultimately, taxpayers, they will come to appreciate the necessity and benefits of such services. I hope that outreach services will be the precursor to the employment of full-time athletic trainers in each high school or district, consistent with the goals of the NATA.

In general, it appears that outreach services in this state are leaning toward a team approach, and putting aside professional “turf” disputes as described by Gould (6). This presence in the high school with a clinical backup team can only help to improve the circumstances of an injured high school athlete.

Although some care is better than no care, further investigation is suggested to
evaluate the quality and consistency of outreach care in comparison to the more traditional full-time, on-site athletic trainer's care. The NATA may be fiscally unrealistic in pressing the goal of having a staff athletic trainer in every high school. This information may signify that outreach services in Wisconsin, although somewhat patchwork in nature, may be the compromise.

References

In Sequence Exercise, published in 1984, the authors take a novel approach in dealing with exercise. In fact, they started from scratch. They state that, traditionally, there are three types of exercise—rehabilitation, recreation, and physical training. Rehabilitation is for the ill or infirm, usually administered in hospitals. Once rehabilitated, the patient no longer needs it. Recreation is for most “average” people. When we do lots of it as a child, it is called play. If you continue it into adult life, it is called sport. Physical training is for athletes—those chosen few who apparently perform just to entertain everyone else. Average people cannot train; it is beyond them.

Systems of exercise and exercise equipment follow three categories. Medical equipment is used by: (1) doctors for the rehabilitation of patients; (2) recreational facilities for school, community, and club use; and (3) training facilities—primarily training fields and weight rooms—for the athletes. People in one group seldom use the approaches, facilities, or equipment used by the other two groups. Average persons don’t lift weights. Not only do they not have the inclination to do so, they assume they lack the strength and skill to lift. Likewise, they don’t use hospital equipment. It probably is both below their level and ability and inaccessible, unless they use it for medical purposes.

Although the authors admit that the three categories persist, they feel that the traditional borders among them are of an artificial nature. After all, the physiological and biomechanical principles governing safe exercise for rehabilitation of injuries should be the same as those that prevent similar injuries in strenuous athletic exercises. The authors discovered that the differences should be of degree, not principle, and they decided that the common denominator is the human being. Therefore, they theorized that there should be one sensible approach suitable for all persons—young and old, women and men, patients, average persons, and top athletes.

That approach is Sequence Exercise, the result of two decades of development. The authors believe that it clearly reflects the concerns that were its origins. It, therefore, differs from all other exercise approaches. The concept has been proven in use by thousands of persons at all levels of physical fitness and is now used on four continents in rehabilitation therapy and in exercise institutes. It has been used in exercise rooms, on offshore oil platforms, and in educational and military physical education facilities. Top international athletes also have used this concept to win medals in the Olympic games.

The text, loaded with illustrations, is divided into four sections. Part one, Finding, addresses the optimum approach to exercise and fitness. Part two, Knowing, presents concepts such as good health, physical attributes, weight, and the need for fitness. In part three, the authors explore the benefits of sequence exercise at home, when traveling, or almost anywhere that you have space to stretch out. They stress the fact that no special equipment is needed, only some ordinary household furnishings. In addition, using conventional weights in a sequence exercise program and performing a sound stretching program are detailed. In Measuring, part four, the authors discuss fitness testing and its role in the total fitness program—what it is and what it is not.

This is an excellent text for world class athletes as well as weekend athletes who have been exercising and not getting the results that they desire. Read this text prior to developing an exercise routine and you will receive maximum results for your efforts.

Knee Pain and Disability
Rene Cailliet, MD
F.A. Davis Company, Philadelphia, Pa
1992
287 pages, Illustrated

Dr. Rene Cailliet prefaces this work with a statement that opens the mind of the reader to the vast and complex world of pain and disability as it relates to the knee joint, “The human knee has for centuries been exposed to numerous traumata, stresses, injuries, and diseases; but it appears that the recent generation has compounded the problem. Physical fitness programs intended for improving general health and cardiovascular conditioning have resulted in unacceptable knee problems.”

The author is professor and chairman emeritus with the Department of Physical Medicine and Rehabilitation within the School of Medicine at the University of Southern California in Los Angeles, Calif. He also serves as director of rehabilitation services at the Santa Monica Hospital Medical Center in Santa Monica, Calif. Dr. Cailliet has completed nine texts that address various areas of injury and pain.

One major topic of discussion at all NATA clinical symposiums is the rapid and massive increase in the body of athletic training knowledge. In the eighth edition of The Trainers Bible, written by the pioneer Dr. S.E. Bilik in 1948, eight pages are devoted to injuries and conditions of the knee joint, including trick knee, trigger knee, torn cartilage, floating cartilage, and slunk knee. In 1949, Dr. Augustus Thordike, team physician at Harvard University, in his classical text, Athletic Injuries, Prevention, Diagnosis and Treatment, devoted twelve pages to knee pain and disability. The point is that we have advanced to the stage where experts such as Dr. Cailliet are now writing volumes on specific injuries and conditions of the knee.

Knee Pain and Disability has nine chapters that address structural anatomy, functional anatomy, meniscus injuries, ligamentous injuries, patellofemoral pain and impairment, arthritides affecting the knee, fractures about the knee joint, congenital and acquired deformities of the knee, and the knee in gait: normal and abnormal. Each chapter is well written and has concise illustrations that add greatly to the understanding of the concepts presented.

The text joins Dr. Rene Cailliet’s other works as a classic in the field of injury and pain, and offers something to all sports medicine professionals from the student athletic trainer to the team physician. It is well worth the cost, and will become one of your most valuable sources of information.
Body Composition/Weight Loss


Stordy BJ. Very low calorie diets should be used. Int J Obes. 1989; 13(suppl 2): 141-149.


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* Clinical Sessions:
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Volume 27 • Number 2 • 1992 • Journal of Athletic Training
Wonderzorb Soft Silicone: Total Comfort for Athletes and Active Lifestyles

Silipos recently introduced their Wonderzorb Molded Medical Grade Silicone Performance products designed to meet the needs of athletes and those whose daily lives demand the same benefits.

Wonderzorb aids in the prevention and rehabilitation of injuries. Using two consistencies of silicone to support the foot and disperse shock and vibration, Wonderzorb is technologically engineered to take pressure off the feet, legs, hips, and back. Wonderzorb has achieved unsurpassed success with relief of stress fractures, shin splints, and other impact-related injuries. Energy return, creating more spring and power, is another feature.

The Wonderzorb models pictured above are: (1) WonderSport, which has a 3/4 insole with a slight cavity at the heel for comfort and protection along the entire foot especially for runners or walkers; (2) WonderCup, which absorbs shock and supports the heel with a stabilizing wall; and, (3) WonderSpur, which, through the placement of a cavity, offers therapeutic relief of the pain caused by bone spurs.

The Wonderzorb soft silicone creates a massaging action with each step while offering increased circulation at bruised area strike points. Wonderzorb offers complete comfort, even during prolonged use, as it combats blisters and callouses and never loses its shape.

The Wonderzorb soft silicone technology coupled with research and development by professional athletes has resulted in an unparalleled product. Wonderzorb soft silicone is washable and suitable for use in virtually any type of athletic footwear.

For additional information, contact Silipos at 2045 Niagara Falls Boulevard, L.P.O. Box 320, Niagara Falls, NY 14304, or in the U.S., call (800) 229-4404, or in Canada, call (800) 345-5103.

New Exercise Program Saves Time

Orthopedic Physical Therapy Products (OPTP) has introduced the new Customized Sticker Exercise Program. This new concept in exercise therapy incorporates the use of peel-off illustrated exercise stickers for customizing patient exercise programs. Patients appreciate the simplicity of the colorful one-page individualized exercise program. Athletic trainers and physical therapists will appreciate the time savings and convenience.

The Customized Sticker Exercise Program is divided into four color-coded sections for easy reference: Stretching, Trunk, Shoulder/Elbow, and Lower Extremity. The health professional selects the appropriate exercise sticker from the more than 80 exercises portrayed, writes in the date, repetitions, duration, weight, and other special instructions, and transfers the sticker to the patient’s individual exercise sheet. The Customized Sticker Exercise Program eliminates the need to photocopy dozens of exercise pages. Instead, each patient leaves therapy with a one-page exercise program tailored specifically to his or her needs.

The Customized Sticker Exercise Program includes instructions, exercise stickers, reorder forms, and patient exercise sheets in a convenient three-ring binder.

For more information, or to order, contact OPTP at PO Box 47009, Minneapolis, MN 55447-0009, or call (800) 367-7393.

Brace International Bar 1 Pants: A Budget Bashing Way to Eliminate Taping

Brace International’s Bar 1 Pants eliminate the need for taping groin strains, hamstring strains, and deep thigh contusions. Each season, athletic trainers and athletes encounter the frustration of these season-long injuries. The comfortable Bar 1 Pants aid in the effective management of such injuries. Made from a wetsuit-like material, the Bar 1 Pants provide valuable heat retention and compression to support the affected muscle group, while the easy to apply elastic straps provide mechanical assistance to the damaged muscle. Wearing Bar 1 Pants hastens the healing process and allows the athlete a safer, more supported return to activity.

For more information, call Brace International at (800) 545-1161.
Model 227 Rocker Balance Square Introduced

Bailey Manufacturing Company’s Model 227 Rocker Balance Square is used by athletes who want to develop and maintain balance control, coordination, and vestibular acuity. The Rocker Balance Square can be used in a sitting, kneeling, or standing position. The top of the Model 227 is an 18-inch square that is covered with carpeting. The overall height is five inches.

The Bailey Manufacturing Company makes other sizes and types of balance aids for use in developing and maintaining motor skills. For more information, contact Bailey Manufacturing at PO Box 130, Lodi, OH 44254-0130, or call (216) 948-1080, (800) 321-8372, Fax (216) 948-4439.

FOOTFLEX: A Convenient Way to Rehabilitate and Prevent Injuries to the Lower Leg and the Foot

FOOTFLEX was developed to assist athletes and others to stretch the arch correctly in unison with the Achilles’ tendon and calf muscles. By flexing the toes upward, the arch is prevented from flattening out when stretching. This biomechanically correct position allows a more thorough stretch of the lower leg and foot than incline boards, towel pulls, and all other known methods and devices that are used to improve lower extremity, foot, and ankle flexibility. By positioning the foot in two planes while dorsiflexing the foot and leg during stretching exercises, more leverage and static control can be applied to the muscles and soft tissue in the lower leg and foot. The FOOTFLEX can help re-establish lower leg and arch flexibility to rehabilitate conditions such as plantar fasciitis, Achilles’ tendonitis, and tight calf, and to prevent injuries to the lower leg and foot.

For more information, contact FOOTFLEX, Inc. at PO Box 900146, Atlanta, GA 30329-0146, or call (404) 934-0846.

Computerized “Flight Simulator” for Sports Testing and Rehabilitation

IMPULSE Technology, Inc. has introduced VIDEO TRAQ™, a closed kinetic chain, functional testing and reha-
Macintosh Version of SportsWare Announced

Computer Sports Medicine, Inc., the maker of SportsWare injury tracking software for IBM computer hardware, has developed a Macintosh compatible version of SportsWare.

Using SportsWare, athletic trainers can record and report evaluation, injury, and treatment information quickly and easily. Once recorded, all information is easily accessible in various report formats at the press of a button.

For more information, contact Computer Sports Medicine, Inc. at 135 Beaver Street, Waltham, MA 02154, or call (617) 894-7751. Both the MAC and IBM versions of SportsWare will be on display at the CSMI booth number 810 at the June 1992 NATA Annual Meeting and Clinical Symposium in Denver, CO.

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... athletic training photo shot, that is.

Send us your photographs that show an athletic trainer in action or that represent what athletic training means to you. For each photo that appears on the cover of the NATA News, we will pay $50 to the photographer. This opportunity is open to anyone, but our goal is to portray athletic training through the eyes of NATA members.

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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 counseling and educating athletes concerning health care). 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. ’
3. Do not return unjustified 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 NATA’s taking action in reviewing and editing your (our) submission, the author(s) underlines hereby transfers, assigns, or otherwise conveys all copyright ownership to the NATA in the event that such work is published by the NATA.”
4. Materials taken from other sources, including text, illustrations, or tables, must be accompanied by a written statement giving the Journal of Athletic Training permission to reproduce the material. Photographs of individuals must be accompanied by a signed photograph release form. Accepted manuscripts become the property of the National Athletic Trainers’ Association, Inc.
5. The Journal of Athletic Training uses a double blind review process. Authors should not be identified in any way except on the title page.
6. Manuscripts are edited to improve the effectiveness of communication between the author and the readers, and to aid the author in presenting work that is compatible with the style policies found in the AMA Manual of Style, 8th ed. (Williams & Wilkins) 1989. The author agrees to accept any minor corrections of the manuscript made by the editor.
7. Published manuscripts and accompanying work cannot be returned. Unused manuscripts will be returned when submitted with a stamped, self-addressed envelope.

**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 1/2 x 11 inch plain paper, double spaced, with one-inch margins.
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. Illustrations
   h. Legends to illustrations
10. Begin numbering the pages of your manuscript with the abstract page as #1; 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 principle reason for the report, it should be in the title. Often both should appear.
12. The title page should include the names, titles, and affiliations of each author, and the name, address, phone number, and fax number of the author to whom correspondence is to be directed.
13. A comprehensive abstract of 75 to 200 words must accompany all manuscripts except tips from the field. Number this page one, type the complete title (but not the author’s name(s) on) the top, skip two lines, and begin the abstract. It should be a single paragraph succinctly summarizing the major intent of the manuscript, the major points of the body, and 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 article.” Also, do not state the abstract with the introduction.
14. List three to six key words or phrases that can be used in a subject index to refer to your paper. These should be on the same page as, and following, your abstract. For tips from the field, 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 developed and stated. Tell why the study needed to be done or the article written, and culminate with a statement of the problem (or controversy). 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 magnitude 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 or main part 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.
   a. The body of an experimental report consists of a methodology section, a presentation of the results, and a discussion of the results. The methodology section should contain sufficient detail concerning the methods, procedures, and apparatus employed so that others can reproduce the results. The results should be summarized using descriptive and inferential statistics, and a few well-planned and carefully constructed illustrations.
   b. The body of a literature review 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. The subsections 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 other factors relevant but not name), chief complaint, history of present complaint (including symptoms), results of physical examination (example: "Physical findings: The patient is a young woman with a history of ankle sprain. On examination, there is pain to palpation of the ankle joint, swelling, and decreased range of motion."").
   d. The body of a research report might include the following sections: introduction, methodology, results, discussion, and conclusions. Each section should be clearly labeled and numbered.
17. The manuscript should not have a separate summary section - the abstract serves as a summary. It is appropriate, however, to tie the article together with a summary or a list of conclusions at the end of the discussion section.
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Introducing DynaSport's Dynamic Duo...

DynaWrap
DynaSport's new and unique "DynaWrap" rippable elastic bandage features:
- A porous all natural adhesive
- Strong and durable back cloth/adhesive provides excellent conformability
- Consistent unwind tension—no ballooning or gaping
- Moisture resistant

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<td>#51-308-9</td>
<td>2&quot; x 7½ yds</td>
<td>24 rolls per case</td>
</tr>
<tr>
<td>#51-309-9</td>
<td>3&quot; x 7½ yds</td>
<td>16 rolls per case</td>
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DynaPlast
This DynaSport elastic tape features an all natural, moisture resistant adhesive combined with a strong back cloth for optimum conformability and strength. DynaPlast’s balanced adhesive gives it a smooth, consistent unwind tension for easy application.

Catalog No.—#51-313-9
Size—3" x 5 yds
Quantity—16 rolls per case

SpeedWrap
DynaSport introduces “SpeedWrap” Athletic tape featuring:
- Consistent unwind tension to the core
- Superb tensile strength
- Extended shelf life
- Manufacturer direct

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<td>#51-310-9</td>
<td>1½&quot; x 15 yds</td>
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<tr>
<td>#51-311-9</td>
<td>2&quot; x 15 yds</td>
<td>24 rolls per case</td>
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PreWrap
DynaSport’s PreWrap underwrap is a highly porous underwrap designed to protect the skin from repeated tapings. It tears easily and conforms well to the skin.

Catalog No.—#51-312-9
Size—2½" x 30 yds
Quantity—48 rolls per case

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Smith & Nephew DonJoy Inc.

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