Journal of Athletic Training

(*Formerly* Athletic Training, Journal of the National Athletic Trainers' Association, *through Vol. 26, 1991*)

NATA

VOLUME 27

NUMBER 2

1992

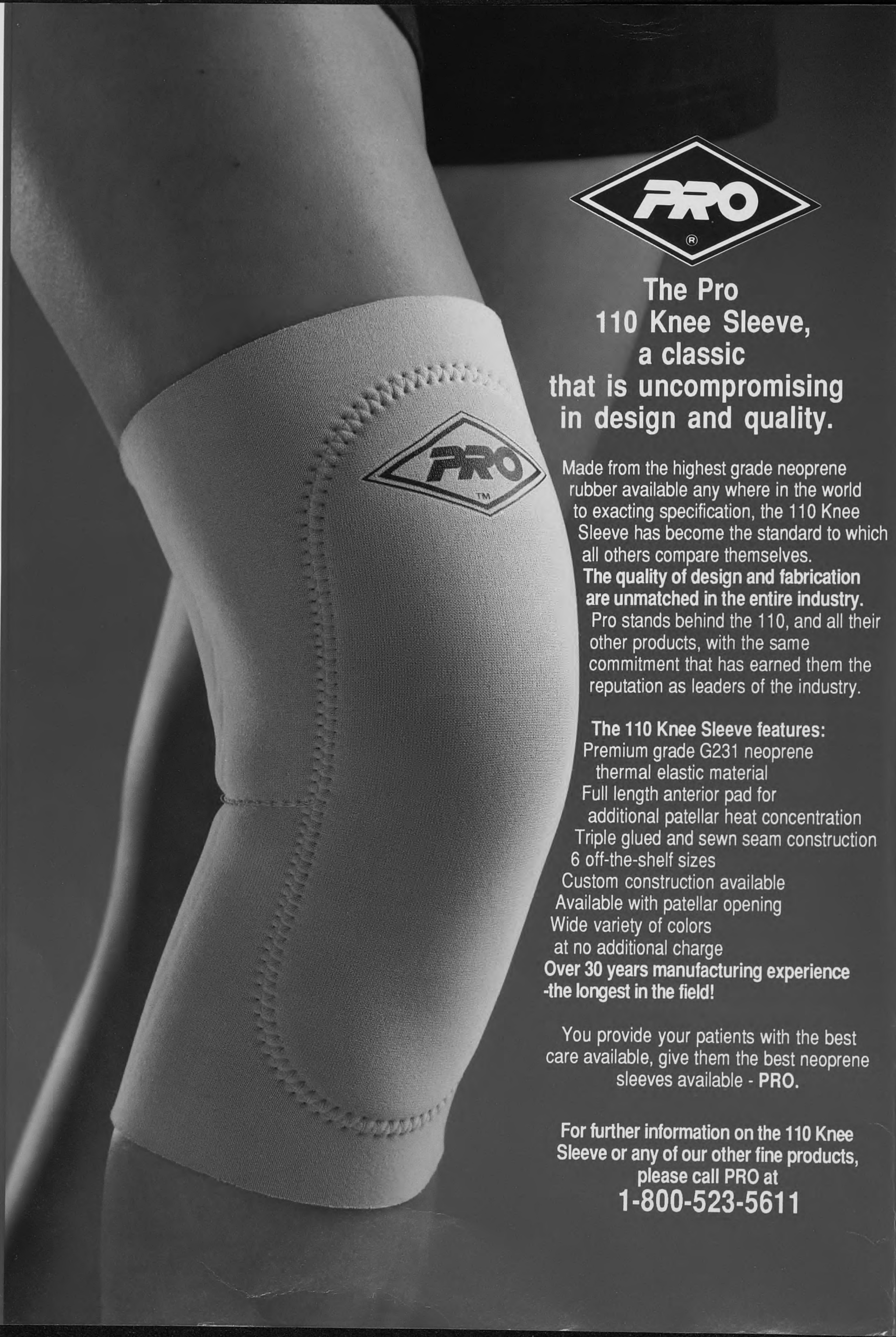
THE NATIONAL

ATHLETIC

TRAINERS'

ASSOCIATION

110 KNEE SLEEVE



JOURNAL OF ATHLETIC TRAINING

Volume 27, Number 2, Summer

formerly, *Athletic Training, JNATA*

The *Journal of Athletic Training* (ISSN 0 160 8320) is published quarterly ($32 for one-year subscription, $40 foreign) by the National Athletic Trainers' Association, Inc., 2952 Stemmons Freeway, Dallas, TX 75247. Second-class postage paid at Dallas, TX, and at additional mailing offices. POSTMASTER: Send address changes to: *Journal of Athletic Training* c/o NATA, 2952 Stemmons Freeway, Dallas, TX 75247. CHANGE OF ADDRESS: Request for address change must be received 30 days prior to date of issue with which it is to take effect. Duplicate copies cannot be sent to replace those undelivered as a result of failure to send advance notice. ADVERTISING: Although advertising is screened, acceptance of the advertisement does not imply NATA endorsement of the product or of the views expressed. Rates available upon request. The views and opinions in the *Journal of Athletic Training* are those of the authors and not necessarily of the National Athletic Trainers' Association, Inc. Printed by The William Byrd Press, Richmond, VA 23261. Produced by the Virginia Health Council, Inc., Richmond, VA 23236.


Performance Demands The Right Equipment.
GOLDPOINT™
BY DONJOY
GOLDPOINT
For Information or Demonstration of the GoldPoint™ Brace
call Toll Free 1-800-3-DONJOY
Smith+Nephew
DJ DONJOY

Journal of Athletic Training

formerly, *Athletic Training, JNATA*

Articles

Departments

Editorial

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

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 them 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.

Conservative Management of Piriformis Syndrome

Douglas R. Keskula, MS, PT, ATC
Michael Tamburello, MS, PT

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 buttock 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.

The piriformis syndrome has been implicated as a potential source of pain and dysfunction, not only in the general population, but in athletes as well (2,8,11). While there is disparity in the literature as to whether this syndrome actually exists (1,8,12), some suggest that it is more prevalent than citations in the literature would indicate (1). Whether or not one embraces this as a clinical entity, our purpose is to provide the reader with an understanding of piriformis syndrome by reviewing the relevant anatomy and the proposed pathomechanics of this syndrome. Moreover, practical and systematic strategies for evaluating and managing the athlete with suspected piriformis syndrome will be offered.

Douglas Keskula is a doctoral candidate at the University of Virginia in Charlottesville, VA.

Michael Tamburello is a commander in the United States Navy and a doctoral candidate at the University of Virginia.

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 dysfunctions. 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.

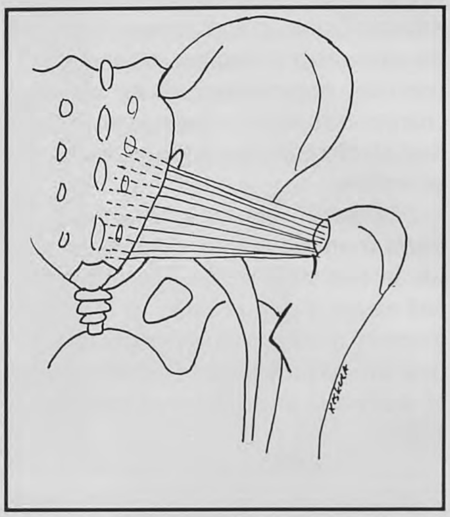


Fig 1.—Posterior view of the pelvis and right proximal lower extremity, illustrating the anatomical relationship between the piriformis muscle and the sciatic nerve

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,

and S3 segments (4). Thus, one can appreciate the constellation of neurological signs and symptoms that could emanate locally or be referred distally to the lower extremity as a result of this syndrome.

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 buttock 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

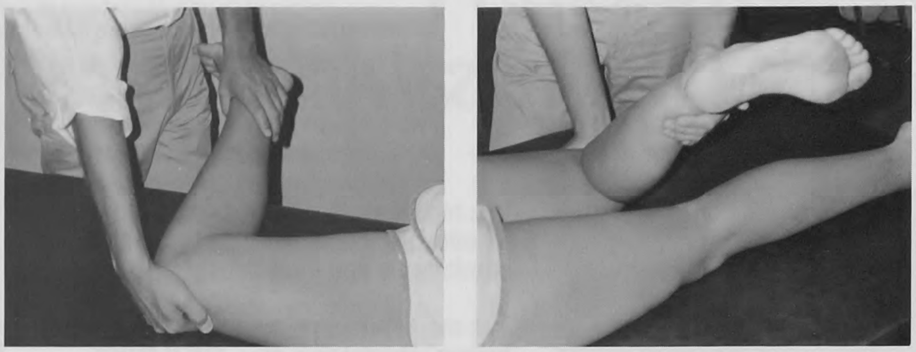
Fig 2.—Conventional manual muscle test position to assess the external rotators of the hip including the piriformis muscle (Adapted from Kendall (6))

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.
8. Assess functional ability and sport-specific activity.
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 3). Testing hip rotation in both neutral and flexed positions provides you with a more comprehensive clinical picture of muscle performance.



A B

Fig 3.—Alternative manual muscle testing positions to assess the piriformis muscle while the hip is in a neutral position. The athlete may be evaluated in A, the prone position, or B, the sidelying position.

Manual muscle testing applied to hip rotation may elicit contractions that are strong, but painful. Because many functional activities are performed while standing, testing in a neutral hip position may provide you with a more functionally applicable strength test.

The piriformis is an abductor of the hip in a flexed position. Carter (2) described an abduction provocation test where the athlete is seated over the edge of the table and asked to push his or her legs apart against maximal manual resistance (Fig 4). The test is positive for a piriformis syndrome if pain is localized directly over the piriformis muscle.

Fig 4.—Manual muscle test for hip abduction with the athlete sitting

Palpation

Careful palpation about the lumbopelvic region not only provides you with information about tissue turgor, but will adequately locate hyperirritable regions in the soft tissues. The piriformis can be difficult to palpate because of the depth of the muscle and the often large mass of overlying muscle and soft tissues. However, 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).

Fig 5.—Anatomical references used to locate the piriformis muscle

Others (2,12) advocate placing the athlete on his or her side with the involved hip flexed, and palpating at the midpoint between the ischial tuberosity and greater trochanter. This position seems to displace the gluteus maximus superiorly to partially uncover the sciatic notch for palpation of the piriformis and sciatic nerve. In addition to assessing tenderness with palpation, you should note evidence of muscular spasm. When using deep palpation to locate suspected trigger areas, be careful when interpreting the athlete's report of pain in this area. This region is normally tender to palpation, and you must compare it with the uninvolved side to verify findings of painful areas. Furthermore, this region is the site of referred pain for lower back disorders and may develop trigger areas that could be confused with piriformis syndrome.

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

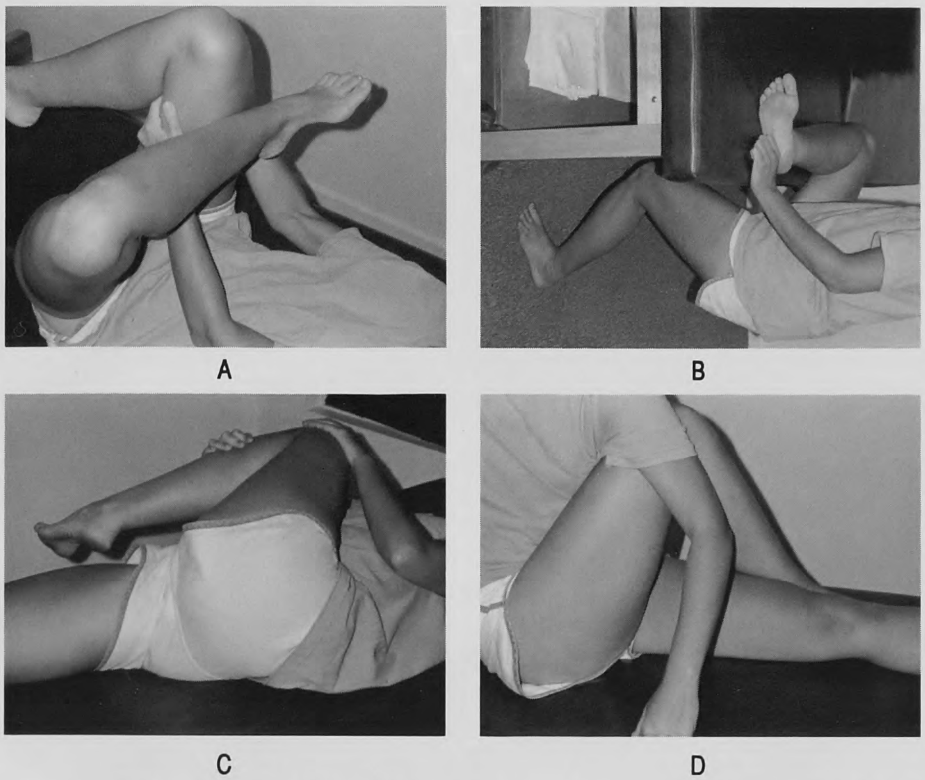


Fig 6.—Suggestions for exercises directed at lengthening the piriformis muscle. When the hip is flexed, the athlete applies pressure into adduction, as in A and B, or external rotation, as in C and D, to stretch the piriformis.

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

A B

Fig 7.—Suggestions for exercises directed at strengthening the piriformis muscle. When the hip is flexed, the athlete abducts the lower extremity, as in A. When the hip is in a neutral position, the athlete externally rotates the thigh, as in B. External resistance may be applied with rubber tubing to either exercise as illustrated in B.

OTIS CLAPP-BUFFINGTON

Better Medications For Occupational Health

- Proven formulas for occupational health
- Backed by 150 years experience
- All non-prescription for safer relief
- Avoids danger of drowsiness
- Meets workers' dietary needs
- Improves productivity and keeps people at work
- Economical to dispense at pennies per dose
- Complete line for best treatment

OTIS CLAPP
Better Medications for Occupational Health

Non-Prescription ■ Salt Free, Sugar Free, Lactose Free, Alcohol Free ■ Avoids Drowsiness

Tablets		Size	Price
ASPERCIN	Finest Quality Aspirin for Pain, Inflammation, Fever (324 mg)	300 Tablets (150x2)	$6.95
ASPERCIN EXTRA	Extra Strength Aspirin for Pain and Inflammation (500 mg)	300 Tablets (150x2)	9.25
BACK-QUELL	Back Pain Relief and Muscle Relaxant Tablets	300 Tablets (150x2)	34.20
BUFFINOL	Buffered Aspirin, Safer to the Stomach (325 mg)	300 Tablets (150x2)	14.90
BUFFINOL EXTRA	Extra Strength Buffered Aspirin, Safer to the Stomach (500 mg)	300 Tablets (150x2)	19.90
DIATROL	Anti-Diarrheal Tablets for Fast, Effective Relief	300 Tablets (150x2)	32.60
DIMACID	Complete Antacid Relief for Heartburn and Sour Stomach	300 Tablets (150x2)	25.80
ELECTROL	Sodium-Free Heat Stress Relief, Replaces Lost Electrolytes	300 Tablets (150x2)	21.50
EMAGRIN	Maximum Strength Salicylate Relief of Pain and Inflammation	300 Tablets (150x2)	20.80
EMAGRIN FORTE	Four Way Cold & Flu Relief Without Drowsiness	300 Tablets (150x2)	31.50
FEMCAPS	Superior Menstrual Relief for Pain and Cramping	300 Tablets (150x2)	34.50
MIGRANOL	Advanced Non-Prescription Relief for Common Migraine Headaches	300 Tablets (150x2)	28.50
ORANYL	Sugar-Free Sinus Decongestant (Pseudoephedrine 30 mg)	300 Tablets (150x2)	17.90
ORANYL PLUS	Sinus Decongestant (30 mg) plus Non-Aspirin Analgesic (500 mg)	300 Tablets (150x2)	27.70
SEPO	Anesthetic Lemon-Lime Throat Lozenges for Soothing Relief	300 Tablets (150x2)	27.40
SILEXIN	Antitussive Stops Coughing and Safely Avoids Drowsiness	300 Tablets (150x2)	36.80
THORETS	Maximum Strength Anesthetic Sugar-Free Throat Lozenges	300 Tablets (150x2)	29.80
ULTRAPRIN	Sugar-Free Ibuprofen Tablets (200 mg) for Deep-Seated Pain	300 Tablets (150x2)	11.90
VALIHIST	Complete Relief for Allergies, Colds, Runny Nose	300 Tablets (150x2)	34.80
VALORIN	Non-Aspirin Pain and Fever Relief (325 mg)	300 Tablets (150x2)	9.90
VALORIN EXTRA	Extra Strength Non-Aspirin Pain and Fever Relief (500 mg)	300 Tablets (150x2)	12.90
VALORIN SUPER	Extra Strength Non-Aspirin (500 mg) Fortified with Caffeine	300 Tablets (150x2)	18.40
Liquids & Ointments			
BURNTAME	Fast-Acting Anesthetic Burn Spray with 20% Benzocaine	2 1/2 oz Spray Can	6.95
LAURO EYE WASH	Sterile Isotonic Eye Wash Flushes Away Eye Irritants	4 oz Bottle	6.75
		1/2 oz Dropper Bottle	4.45
OBTUNDIA ANTISEPTIC	Full Spectrum Antiseptic-Anesthetic Wound Treatment	2 1/2 oz Spray Can	7.65
		3/4 oz Dropper Bottle	5.65
		100 Swab Pads	24.50
OBTUNDIA CALAMINE	Anesthetic Calamine Cream for Rashes and Itching	36 x .11 oz Packets	26.60
		2 oz Tube	6.45
OBTUNDIA CREAM	Antiseptic-Anesthetic Protectant Cream for Wounds and Burns	36 x .11 oz Packets	24.90
		1 1/4 oz Tube	5.25
SANCHIA SILICONE	"Invisible Glove" Protective Hand Cream for Medical Clinic Use	24 x 3/4 oz Tubes	43.40
		3 oz Tube	5.35
SILEXIN SYRUP	Sugar-Free Cough Syrup Without Drowsiness, Alcohol or Narcotics	12 x 1 1/2 oz Bottles	29.80
		16 oz Bottle	17.90
STIMURUB CREAM	Greaseless Analgesic Cream Soothes Sore Muscles	36 x 1/4 oz Tubes	46.70
		16 oz Jar	29.80
		1 oz Tube	5.25

Order from your local supplier

OTIS CLAPP
Quality & Integrity Since 1840

115 Shawmut Road, P.O. Box 9160
Canton, MA 02021-9160
Tel: (617) 821-5400 Fax: (617) 821-5409

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

1. Cameron HU, Noftal F. The piriformis syndrome. *Can J Surg*. 1988; 31:210.
2. Carter AT. Piriformis syndrome: hidden cause of sciatic pain. *Athletic Training, JNATA*. 1988; 23:243-245.
3. Goodgold J, Eberstein A. *Electrodiagnosis of Neuromuscular Diseases*. 2nd ed. Baltimore, Md: Williams & Wilkins Company; 1987: 129.
4. Hollinshead WH, Rosse C. *Textbook of Anatomy*. 4th ed. Philadelphia, Pa: Harper and Row Publishers; 1985: 365, 386.
5. Kapandji IA. *The Physiology of Joints*. 2nd ed. London: Churchill Livingstone; 1970: 68.
6. Kendall FP, McCreary EK. *Muscles Testing and Function*. 3rd ed. Baltimore, Md: Williams and Wilkins; 1983: 172.
7. Kopell H, Thompson W. *Peripheral Entrapment Neuropathies*. Huntington, NY: Krieger; 1975: 66.
8. Kuland DN. *The Injured Athlete*. 2nd ed. Philadelphia, Pa: JB Lippincott Company; 1988: 422-423.
9. Lehmkuhl LD, Smith LK. *Brunnstrom's Clinical Kinesiology*. 4th ed. Philadelphia, Pa: FA Davis; 1984: 278-284.
10. Magee DJ. *Orthopedic Physical Assessment*. Philadelphia, Pa: WB Saunders; 1987: 199.
11. Pace J, Nagle D. Piriformis syndrome. *West J Med*. 1976; 124: 435-439.
12. Papadopoulos SM, McGillicuddy JE, Albers JW. Unusual cause of piriformis muscle syndrome. *Arch Neurol*. 1990; 47: 1144-1146.
13. Prentice WM. *Rehabilitation Techniques in Sports Medicine*. St. Louis, Mo: Times Mirror/Mosby; 1990: 73-85.
14. Saunders HD. *Evaluation, Treatment and Prevention of Musculoskeletal Disorders*. Eden Prairie, Minn: Educational Opportunities; 1985: 155-156.
15. Steindler A. *Kinesiology of the Human Body*. 4th ed. Springfield, Ill: Charles C. Thomas Publisher; 1976: 296.
16. Sullivan PE, Markos PD, Minor MD. *An Integrated Approach To Therapeutic Exercise*. 1st ed. Reston, Va: Reston Publishing Company; 1984: 135-156.
17. Voss DE, Ionta MK, Myers BJ. *Proprioceptive Neuromuscular Facilitation*. 3rd ed. Philadelphia, Pa: Harper and Row Publishers; 1985: 116-127.
18. Warren CG, Lehmann JF, Koblanski BS. Heat and stretch: an evaluation using rat tail tendons. *Arch Phys Med Rehabil*. 1976; 57:122-126.

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.

William Cornelius is an associate professor of education with the University of North Texas Department of Kinesiology, Health Promotion, and Recreation in Denton, TX.

Mary Hands is a personal trainer and fitness consultant in Fort Worth, TX.

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 chest deep in 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 whirlpool bath; therefore, this time was used for all three groups.

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.

Fig 1.—The subject pushes her leg against the examiner during stretching.

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 to the athletic trainer and other medical personnel could be examined in conjunction with modified PNF stretching techniques.

References

1. Anderson B, Beaulieu JE, Cornelius WL, Dominquez RH, Prentice WE, Wallace L. Roundtable: flexibility. *Natl Strength Cond Assoc.* August/September 1984; 6:10-22, 71-73.
2. Baun WB, Baun MR, Raven PB. A nomogram for the estimate of percent body fat from generalized equations. *Res Q.* 1981; 52:380-384.
3. Beaulieu JE. Developing a stretching program. *Phys Sportsmed.* November 1981; 9:59-69.
4. Corbin CB, Noble L. Flexibility: a major component of physical fitness. *J Phys Educ Rec.* 1980; 51:23-60.
5. Cornelius WL. Flexibility: the effective way. *NatStrength CondAssoc J.* June/July 1985; 7:62-64.
6. Cornelius WL, Craft-Hamm K. The acute effects of proprioceptive neuromuscular facilitation flexibility techniques on arterial blood pressure. *Phys Sportsmed.* April 1988; 16:152-161.
7. Cornelius WL, Hayes KK. A comparison of single vs. repeated PNF flexibility maneuvers on hip joint range of motion. *J Appl Sports Sci Res.* November/December 1987; 1:71-73.
8. Cornelius WL, Hinson MM. The relationship between isometric contractions of hip extensors and subsequent flexibility in males. *J Sports Med Phys Fitness.* 1980; 20:75-80.
9. Cornelius WL, Rauschuber MR. The relationship between isometric contraction durations and improvement in acute hip joint flexibility. *J Appl Sports Sci Res.* August/September 1987; 1:39-41.
10. deVries HA. Evaluation of static stretching procedures for improvement of flexibility. *Res Q.* 1962; 33:222-229.
11. Hardy L. Improving active range of hip flexion. *Res QExerc Sport.* 1985; 56:111-114.
12. Holt LE. *Scientific Stretching for Sport (3-S).* Halifax, Nova Scotia: Sport Research Limited; 1976: 1-2.
13. Laban MM. Collagen tissue: implications of its response to stress in vitro. *Arch Phys Med Rehabil.* 1966; 43:461-466.
14. Lehmann JF, DeLateur BJ. Therapeutic heat. In: Lehmann, JF. ed. *Therapeutic Heat and Cold.* 3rd ed. Baltimore, Md: Williams and Wilkins Co; 1982: 404-405, 428.
15. Lehmann JF, Masock AJ, Warren CG, Koblanski JN. Effect of therapeutic temperatures on tendon extensibility. *Arch Phys Med Rehabil.* 1970; 51:481-487.
16. Leighton JR. A simple objective and reliable measure of flexibility. *Res Q.* 1942; 13:205-216.
17. Michlovitz SL. Biophysical principles of heating and superficial heat agents. In: Michlovitz SL. ed. *Thermal Agents in Rehabilitation.* Philadelphia, Pa: F.A. Davis Co; 1986: 105-106.
18. Prentice WE. A comparison of static stretching and PNF stretching for improving hip joint flexibility. *Athletic Training, JNATA.* 1983; 18:56-59.
19. Sapega AA. Quendenfeld TC, Moyer RA, Butler RA. Biophysical factors in range of motion exercise. *Phys Sportsmed.* 1981; 9(12):57-65, 106.
20. Schultz P. Flexibility: day of the static stretch. *Phys Sportsmed.* November 1979; 7:109-117.
21. Stolov W, Weilepp TG, Riddell WM. Passive length-tension relationship and hydroxyproline content of chronically denervated skeletal muscle. *Arch Phys Med Rehabil.* 1970; 51:517-525.
22. Tanigawa MC. Comparison of the hold-relax procedure and passive mobilization on increasing muscle length. *Phys Ther.* 1972; 52:725-735.
23. Wallin D, Ekblom B, Grahn R, Nordenborg T. Improvement of muscle flexibility: a comparison between two techniques. *Am J Sports Med.* 1985; 13:263-268.
24. Warren CG, Lehmann JF, Koblanski JN. Elongation of rat tail tendon: effect of load and temperature. *Arch Phys Med Rehabil.* 1971; 52:465-474.
25. Warren CG, Lehmann JF, Koblanski JN. Heat and stretch procedures: an evaluation using rat tail tendons. *Arch Phys Med Rehabil.* 1976; 57:122-126.
26. Williford HN, East JB, Smith FH, Burry LA. Evaluation of warm-up for improvement in flexibility. *Am J Sports Med.* 1986; 14:316-319.
27. Williford HN, Smith JF. A comparison of proprioceptive neuromuscular facilitation and static stretching techniques. *Am Correct Ther J.* 1985; 39:30-33.
28. Winer, BJ. *Statistical Principles in Experimental Design.* New York, NY: McGraw-Hill Book Co; 1971: 149-260.

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.

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

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 ½ 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 developing water intoxication than some men (20).

Exercise-induced Hyponatremia

The most likely cause of exercise-induced hyponatremia appears to be a combination of moderate salt loss through sweat with retention of high volumes of ingested 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 ultraen- durance 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 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 120mEq/L (9). Symptoms include disorientation, confusion, restlessness, slurred speech (9), heat cramps (10), muscle twitching, muscle fasciculation 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 osmolarity, 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 500ml per hour (22), which should include drinking fluids with a low sodium content (24). Ross (28) suggests ingesting an electrolyte solution containing 10m/Eq of sodium, 10m/Eq of chloride, and 5m/Eq 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 endurance and ultraendurance athletes need to be educated about the prevention, recognition, and treatment of this condition. Further investigation of the possible incidence of hyponatremia in other athletic settings, such as preseason football camp during the hot weather months, needs to be conducted.

References

1. Adner MM, Scarlet JJ, Casey J, Robison W, Jones BH. The Boston marathon medical care team: ten years of experience. *Phys Sportsmed.* July 1988; 16:98-108.
2. American College of Sports Medicine. Position statement on prevention of heat injuries during distance running. *Med Sci Sport Exer.* 1975; 7:vii-viii.
3. Arieff AI, Llach F, Massry SG. Neurological manifestations and morbidity of hyponatremia: correlation with brain water and electrolytes. *Medicine.* 1976; 55:121-129.
4. Cohen I, Zimmerman AL. Changes in serum electrolyte levels during marathon running. *South Afr Med J.*1978; 53:449-453.
5. Costill DL. Sweating: its composition and effects on body fluids. *Ann NY Acad Sci.* 1977; 301:160-174.
6. Costill DL, Miller JM. Nutrition for endurance sport: carbohydrate and fluid balance. *Int J Sports Med.* 1980; 1:2-14.
7. Dolinar J. Triathalons—not just for ironmen. *Phys Sportsmed.* October 1990; 18:120-125.
8. Eichner ER. Sacred cows and straw men. *Phys Sportsmed.* July 1991; 19:24.
9. Frizzell RT, Lang GH, Lowance DC, Lathan SE. Hyponatremia and ultramarathon running. *JAMA.* 1986; 255:772-774.
10. Hiller DB. Dehydration and hyponatremia during triathlons. *Med Sci Sport Exer.* 1989; 21S:219-221.
11. Hiller DB, O'Toole ML, Fortess EE, Laird RH, Imbert PC, Sisk TD. Medical and physiological considerations in triathlons. *Am J Sports Med.* 1987; 15:164-167.
12. Hiller DB, O'Toole ML, Laird RH. Hyponatremia and ultramarathons. *JAMA.* 1986; 256:313.
13. Hiller DB, O'Toole ML, Massimino F. Plasma electrolyte and glucose changes during the Hawaiian Ironman Triathlon. *Med Sci Sport Exer.* 1985; 17S:219.
14. Hubbard RW, Armstrong LE. Hyperthermia: new thoughts on an old problem. *Phys Sportsmed.* June 1989; 17:97-113.
15. Levin ML. Hyponatremic syndromes. *Med Clin North Am.* 1978; 62: 1257-1271.
16. Morgan DB, Thomas TH. Water balance and hyponatremia. *Clin Sci.* 1979; 56:517-522,
17. Murphy P. Ultrasports are in—in spite of injuries. *Phys Sportsmed.* January 1986; 14:180-189.
18. Nelson PB, Robinson AG, Kapoor W, Rinaldo J. Hyponatremia in a marathoner. *Phys Sportsmed.* October 1988; 16:78-88.
19. Noakes TD. Why endurance athletes collapse. *Phys Sportsmed.* September 1988; 16:23-26.
20. Noakes TD. Why marathon runners collapse. *South Afr Med J.* 1988; 73:569-570.
21. Noakes TD, Adams BA, Myburgh KH, Greeff C, Lotz T, Nathan M. The danger of an inadequate water intake during prolonged exercise: a novel concept revisited. *Eur J Appl Physiol.* 1988; 57:210-219.
22. Noakes TD, Berlinski N, Solomon E, Weight, L. Collapsed runners: blood biochemical changes after IV fluid therapy. *Phys Sportsmed.* July 1991; 19:70-82.
23. Noakes TD, Goodwin N, Rayner BL, Branken T, Taylor RK. Water intoxication: a possible complication during endurance exercise. *Med Sci Sport Exer.* 1985; 17:370-375.
24. Noakes TD, Norman RJ, Buck RH, Godlonton J, Stevenson K, Pittaway D. The incidence of hyponatremia during prolonged ultraendurance exercise. *Med Sci Sport Exer.* 1990; 22:165-170.
25. Noble HB, Porter M, Grogg EP, Robinson M. The prairie state games: organization of medical care. *Phys Sportsmed.* February 1988; 16:95-106.
26. Norman RJ, Godlonton J, Buck RH, Couts PB. Why marathon runners collapse. *South Afr Med J.* 1988; 74(9):246.
27. Pacelli LC. Overhydration: is it possible? *Phys Sportsmed.* August 1990; 18:29-30.
28. Ross R. Medical coverage of endurance events. *Phys Sportsmed.* November 1987; 15:140-146.
29. Thomas CL. *Taber's Cyclopedic Medical Dictionary.* 15th ed. Philadelphia, Pa: F.A. Davis Co; 1985.

The Incidence of Spearing by High School Football Ball Carriers and Their Tacklers

Jonathan F. Heck, MS, ATC

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 (NFSHSA) changed their football rules, making the deliberate use of the helmet to ram or punish (spear) an opponent illegal (9). The NCAA and the NFSHSA 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).

Jon Heck is head athletic trainer for Stockton State College in Pomona, NJ.

Fig 1.—Ball carrier spearing, an often overlooked danger for ball carriers, increases the risk of head and neck injury.

Fig 2.—Ball carriers speared 167 times and on 19% of the plays during the course of this study.

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 spearing as defined for this study. Therefore, incidents of concurrent defensive spearing were considered only after ball carrier spearing had been established. This study excluded all other types of defensive spearing.

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 spearing, and concurrent defensive spearing—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 spearing was 18.6 (SD 3.0) per game. The mean score for incidents of concurrent defensive spearing per game was 9 (SD 2.3).

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

Discussion

Ball Carrier Spearing

Ball carrier spearing is dangerous for two reasons. First, spearing 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 spearing has been an overlooked hazard of being a ball carrier.

Only in three games were there less than seven ball carrier spears for a team. Two factors that possibly could have caused a lower number of ball carrier spears 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 spearing, because the opportunities to spear were decreased.

A high number of passing attempts also could have lowered the incidence of ball carrier spearing. 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 spearing.

Concurrent Defensive Spearing

The data indicated that for every two incidents of ball carrier spearing there was one incident of concurrent defensive spearing. The cumulative incidence per game of concurrent defensive spearing also 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 spearing 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 spearing and concurrent defensive spearing, although it cannot be substantiated by this study. Further research needs to be done comparing the incidence of general defensive spearing to the incidence of concurrent defensive spearing.

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 spearing by ball carriers. The literature mentions the danger of spearing 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 spears (BCS), concurrent defensive spears (CDS) and the incidence of ball-carrier spearing and concurrent defensive spearing per game

	GAME 1	2	3	4	5	6	7	8	9	Total
TP	88	87	102	107	101	105	89	90	85	854
UP	1	6	1	4	3	2	1	4	5	27
BCS	20	22	18	20	18	22	13	15	19	167
CDS	7	11	5	8	7	10	8	5	11	72
BCS/PLAY	1/4.4	1/4.0	1/5.7	1/5.4	1/5.6	1/4.8	1/6.9	1/6.0	1/4.5	1/5.1
CDS/BCS	1/2.9	1/2.0	1/3.6	1/2.5	1/2.6	1/2.2	1/1.6	1/3.0	1/1.7	1/2.3

Fig 3.—One of the options for a tackler (white jersey) who has a spearing ball carrier (dark jersey) running toward him is to make the tackle with the ball carrier's helmet in his abdomen.

Fig 4.—The defender (dark jersey) has attempted to get lower than the spearing ball carrier (white jersey) and has initiated contact using the crown of his helmet.

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 also were 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

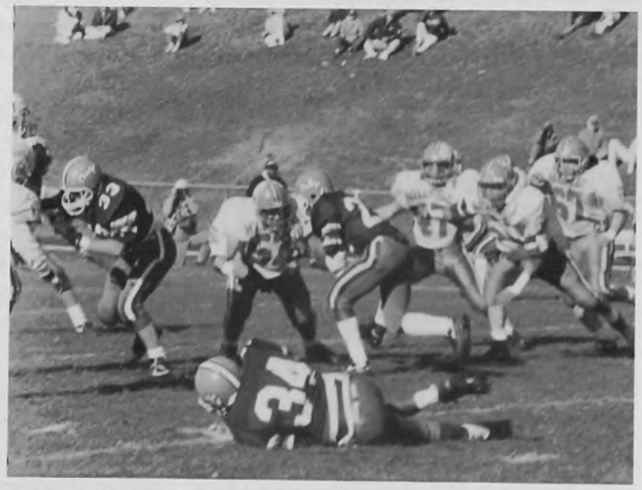


Fig 5.—With the head up, the ball carrier and tackler can prepare the neck musculature for impact.

Fig 6.—Initiating contact with the shoulder and keeping the neck extended reduces the risk of head and neck injury for the tackler and the ball carrier.

extended (Fig 6). This places the head and cervical spine in the least amount of danger. But this technique must be practiced until a player overcomes the powerful instinct to protect his eyes and face by lowering his head at contact.

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 techniques are imperative for the prevention of injury.

I believe it also is extremely important for the coaching staff to have a strict enforcement policy for dealing with spearing during practice. Spearing at any time should not slip by the coach's or athletic trainer's attention without their attempting to correct the player's technique.

Ultimately, I think that it is the responsibility of the athletic trainer to ensure that 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 heirarchy 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

1. Albright JP, Mcauley E, Martin RK, Crowley ET, Foster DT. Head and neck injuries in college football: an eight-year analysis. *Am J Sports Med.* 1985; 13:147-152.
2. Buckley WE. Concussions in college football. *Am J Sports Med.* 1988; 16:51-56.
3. Football-related spinal cord injuries among high school players-Louisiana, 1989. *MMWR.* 1990; 39:586-587.
4. Hodgson VR, Thomas LM. Play head-up football. *Natl Fed News.* 1985; 2:24-27.
5. Kuland KN. *The Injured Athlete.* 2nd ed. Philadelphia, Pa: Lippincott Co.; 1988:288.
6. Leidholt JD. Spinal injuries in athletes: be prepared. *Orth Clin N Am.* 1973; 4:691-707.
7. Mueller FO, Blyth CS. Fatalities from head and cervical spine injuries occurring in tackle football: 40 years' experience. *Clin Sports Med.* 1987; 6:185-196.
8. Mueller FO, Blyth CS, Cantu RC. Catastrophic spine injuries in football. *Phys Sportsmed.* October 1989; 17:51-53.
9. National Collegiate Athletic Association. NCAA football rules and/or modifications, Rule 2, Section 24; Rule 9, Section 1, Article 2-L; Rule 9, Section 1, Article 2-N. Jan 23, 1976.
10. Ramotar JE. News briefs: no direct deaths in high school football. *Phys Sportsmed.* September 1991; 19:48-50.
11. Torg JS. Epidemiology, pathomechanics, and prevention of athletic injuries to the cervical spine. *Med Sci Sports Exerc.* 1985; 17:295-303.
12. Torg JS. The epidemiologic, biomechanical, and cinematographic analysis of football induced cervical spine trauma. *Athletic Training, JNATA.* 1990; 25:147-159.
13. Torg JS, Quedenfeld TC, Moyer RA, Truex R, Spealman AD, Nichols CE. Severe catastrophic neck injuries resulting from tackle football. *J Am Coll Health Assoc.* 1977; 25:224-266.
14. Torg JS, Sennett B, Vegso JJ. Spinal injury at the third and fourth cervical vertabrae resulting from the axial loading mechanism: an analysis and classification. *Clin Sports Med.* 1987; 6:159-185.
15. Torg JS, Vegso JJ, Sennett B. The national football head and neck injury registry: 14-year report on cervical quadriplegia. *Clin Sports Med.* 1987; 6:61-72.
16. Virgin H: Cineradiographic study of football helmets and the cervical spine. *Am J Sports Med.* 1980; 8:310-317.
17. Watkins RG: Neck injuries in football players. *Clin Sports Med.* 1986; 5:215-247.

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 strength training. 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).

Len Finamore is head athletic trainer/educator at Catholic Memorial High School in West Roxbury, MA.

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 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 dead lift. 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.

Selected Questions and Responses (N=182) in a Survey of Massachusetts High School Football Team Strength and Conditioning Programs

Question	Responses N	%	Question	Responses N	%
Who Develops and Supervises the Strength and Conditioning Program?			**Body Area Emphasized During Strength Program**		
Football Coach	126	69%	Shoulder	22	12%
Athletic Trainer	4	2%	Back/Hip	20	11%
Strength Coach	7	4%	Knee	55	30%
Former Player	11	6%	Ankle	12	7%
Present Player	16	9%	Neck	73	40%
Teacher	9	5%			
Parent/Other	9	5%	**Basic Goals and Objectives of the Strength Program**		
Goals and Objectives in Testing Football Athletes			To improve athletic performance	62	34%
To determine strengths and weaknesses	42	23%	To prevent injury	67	37%
To set goals	37	20%	To increase size and weight	29	16%
To identify potential injuries	11	6%	To improve mental attitude	24	13%
To motivate	47	26%	**Type of Training Modalities Preferred**		
To profile each athlete	25	14%	Isotonic Free Weights	96	53%
To evaluate the effectiveness of your program	20	11%	Isotonic Variable Resistance (Machines)	49	27%
Best Single Indicator of Football Playing Ability			Isometrics	4	2%
Muscular Strength	15	8%	Isokinetics (Cybex, KinCom, Orthotron)	1	.4%
Muscular Endurance	15	8%	Partner Resistance	11	6%
Muscular Power	15	8%	Gymnastic Exercises	7	4%
Flexibility	16	9%	Any combination of the above	13	7%
Cardiovascular Endurance	11	6%	**Strength Training Injuries Encountered**		
Agility	31	17%	Lower Back/Hip	89	49%
Speed	33	18%	Neck	7	4%
Body Composition	1	.3%	Shoulder/Chest	47	26%
All of the above	45	25%	Groin	23	12%
			Elbow	16	9%
Area of the Body Most Commonly Injured			**Core (or Main) Exercise(s) Used in Strength Program**		
Head	1	.4%	Power Clean	22	12%
Hip/Lower Back	7	4%	Dead Lift	17	10%
Neck	7	4%	Squat Lift	44	24%
Thigh/Knee	49	27%	Bench Press	53	29%
Shoulder/Arm	25	13%	Military Press	22	12%
Lower Leg	7	4%	Calf Raise	13	7%
Ankle/Foot	69	38%	Nautilus Circuit	11	6%
Forearm	1	.4%			
Wrist/Hand	16	9%			

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.

XAN CORP

WHAT HAS SEATTLE GOT?
(and maybe YOU haven't got!)

We don't usually publish our fan letters. But this is different. When someone of the stature of Jim Whitesel, head trainer for the Seattle Seahawks writes ... shouldn't he be heard? Besides, his experiences may mean something to you!!

We invite you to check out the ZAINON ROLL-ONS at our booth at the NATA Annual Meeting.

Yours in sports safety,

Bill Friedland

Tom Eck

July 18, 1991

Mr. Bill Friedland
XAN Corp.
P. O. Box 13189
St. Petersburg, FL 33733-3189

Dear Bill:

It was wonderful spending time with you at the NATA national meeting and I would like to reiterate how well the Zainon 10 and 9 have worked for the Seahawks.

I was a little skeptical at first in using the product but after player response, there are few items in my training room which have given results like the Zainon.

The product has given consistent reduction in inflammatory cases and has given me a modality that I can send home with the athlete for continued therapy away from the training room.

I hope that other professionals will find the same results that I have by giving your product an evaluation and consistent use.

Thanks again for sharing your expertise with me and my players thank you for their well-being.

Yours in sports safety,

Jim Whitesel

Jim Whitesel, M.S. A.T.,C.
Head Trainer
SEATTLE SEAHAWKS

JW/gl

Seattle Seahawks

XAN CORP. P.O. Box 13189 St. Petersburg, Florida 33733-3189 (813) 576-1200 FAX: (813) 576-6688

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 (5).

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:

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.

References

1. Allerheiligen B. Testing for football. *Natl Strength Cond Assoc J.* October/November 1983; 5:16-18.
2. Barton B, Cain S. Understanding injury in its relationship to strength and flexibility. *Natl Strength Cond Assoc J.* April 1986; 8:14-24.
3. Beaulieu JE: Developing a stretching program. *Phys Sportsmed.* November 1981; 9:61.
4. Culpepper MI, Morrison T. High school football game injuries from four Birmingham municipal fields. *Ala Med.* 1987; 24:378-382.
5. deVries HA. *Physiology of Exercise for Physical Education and Athletics.* 4th ed. Dubuque, IA: Wm C Brown; 1986:42-43, 467, 482-483.
6. Dunn B, Klein K, Kroll B, McLaughlin TM, O'Shea PO, Wathan D. The squat and its application to athletic performance. *Natl Strength Cond Assoc J.* June 1984; 6:10-22, 68.
7. Fleck SJ, Falkel JE. Value of resistance training for the reduction of sports injuries. *Sports Med.* 1986;3:61-68.
8. Foran B. Advantages and disadvantages of isokinetics, variable resistance and free weights. *Natl Strength Cond Assoc J.* February 1985; 7:24-25.
9. Gallagher SS, Finison K. The incidence of injuries among 87,000 Massachusetts' children and adolescents: results of the 1980-81 statewide childhood injury prevention program surveillance system. *Am J Public Health.* 1984; 74:1340-1346.
10. Hejna WF, Rosenberg A. The prevention of sports injuries in high school students through strength training. *Natl Strength Cond Assoc J.* February 1982; 4:28-31.
11. Micheli LJ. Injuries to the young athlete. Presented at the Sportsmedicine Seminar Injuries to Young Athletes: Prevention and Care by the Cape Cod Rehabilitation Physical Therapy and Sportsmedicine; August 5, 1988; Falmouth, MA.
12. Micheli LJ. Preventing youth sport injuries. *JPERD.* 1985; 56:52-54.
13. Olson OC. The Spokane study: high school football injuries. *Phys Sportsmed.* December 1979; 7:75-82.
14. Panariello R. Beyond pylometrics: other conditioning and rehabilitation techniques for athletes. Presented at the annual meeting of Athletic Trainers of Massachusetts; June 10-11, 1988; Norton, MA.
15. Pauletto B. Choice and order of exercises. *Natl Strength Cond Assoc J.* February 1986; 8:71-73.
16. Pritchett J. A statistical study of knee injuries due to football in high school athletes. *J Bone Joint Surg.* 1982; 64-A:240-241.
17. Pritchett J. High cost of high school injuries. *Am J Sports Med.* 1980; 8:197-199.
18. Riley D. Strength training for the neck. *Phys Sportsmed.* May 1981; 9:165.
19. Statewide Comprehensive Injury Prevention Program (SCIPP). *Massachusetts High School Athletic Programs: A Status Report.* Boston, MA: Bureau of Parent, Child and Adolescent Health, Massachusetts Department of Public Health; 1989:1-4.
20. Stone M, O'Bryant H. *Weight Training: A Scientific Approach.* Minneapolis, Minn: Burgess International Group, Inc; 1987:114.
21. Thompson RR. A study of the type and cost of football injuries. *Minn Med.* 1986; 69:656-658.
22. Wathen D, Borden R. Prevention of athletic injuries through strength and conditioning. *Natl Strength Cond Assoc J.* April 1983; 5:14-19.
23. Watters DAK, Brooks S. Sports injuries in an accident and emergency department. *Arch Emerg Med.* 1984; 2:105-112.
24. Weineck J. *Functional Anatomy in Sports.* Chicago, Ill: Yearbook Medical; 1986:110.
25. Westcott WL. Strength training for injury prevention. *Schol Coach.* October 1986; 56:62, 65, 71.
26. Westcott WL, Finamore LV. Survey of football injuries and conditioning programs in Massachusetts. *Schol Coach.* May 1990; 59:14, 16.
27. Wilkerson GB. Developing flexibility by overcoming the stretch reflex. *Phys Sportsmed.* September 1981; 9:189.
28. Zohar J. Preventive conditioning for maximum safety and performance. *Schol Coach.* April 1973; 38:65, 115.

▪ CEU Credit Quiz ▪

This CEU Credit Quiz contains questions drawn from the following articles:

Keskula, Tamburella: *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*
Finamore: *Survey of Football Team Strength and Conditioning Programs*
Heck: *The Incidence of Spearing by High School Football Ball Carriers and Their Tacklers*

The NATA Board of Certification accepts this continuing education offering for .3 hours of prescribed CEU credit in the program of the National Athletic Trainers' Association, Inc., provided that the test is used and completed as designed.

To participate in this program, read the material carefully, photocopy the test on the next page, and answer the test questions. Mark your answer by circling the correct letter. Then fill in your name, address, and other information and mail with $12 for processing to the address on the next page. **FOR CREDIT, the form must reach Indiana State University by August 30, 1992.**

A passing score is 70%. We will notify the NATA Board of Certification of all persons who score 70% or better, and the NATA will enter .3 CEU credit on those persons' records. Participation is confidential.

Answers to previous CEU Credit Quiz *will appear in Volume 27, Number 3, 1992.*

NATA BROCHURES & VIDEO NOW AVAILABLE!

Athletic Training Career Information (Brochure)
This brochure provides an introduction to athletic training and the NATA. A brief overview of the NATA is given, as well as an explanation of the job responsibilities of an athletic trainer and the way to become an ATC.

Increase Your Injury Awareness (Brochure)
Targeted toward secondary school settings, this brochure explains the job responsibilities of athletic trainers and the important role that they play in high school athletics. It also explains to employers how to hire an ATC.

NATA Job Referral Service (Brochure)
This brochure explains how to use the NATA Job Hotline, Bulletin Board, and Job Referral List. It also explains to employers how to list a job opening.

Athletic Trainers: Treating Athletes Better (Video)
Eleven minutes in length, this video (VHS format only) gives an in-depth explanation of the role that an athletic trainer plays in the health care system. The six domains are explained, as well as the educational requirements needed to become an ATC.

HOW TO ORDER
To order any of the NATA brochures or the video, please complete the Request Form, include the appropriate payment, if any, and mail to the address indicated.

BROCHURES
Any order of less than 50 brochures is free of charge. Orders for more than 50 brochures will be charged $5.00 for shipping and handling for each set of 50 brochures. (See the Request Form for examples.)

VIDEOS
There is a $10.00 duplication and shipping fee for each video.

• *Phone orders will not be accepted.* •

REQUEST FORM

Name: ____________________

Mailing Address: ____________________

City/State/Zip: ____________________

NATA Membership #: ____________________

Employer: ____________________

BROCHURES — Number Requested

❐ Athletic Training Career Information ______

❐ Increase Your Injury Awareness ______

❐ NATA Job Referral Service ______

VIDEO

❐ Athletic Trainers: Treating Athletes Better ______

BROCHURES

Number Ordered	Shipping / Handling
0-50:	No charge
51-100:	$ 5.00
101-150:	$10.00
151-200:	$15.00
VIDEO:	$10.00 per video

Total # of brochures requested: ______

TOTAL ENCLOSED: $ ______

Make checks payable to: NATA

Please return this form, and your payment to:
NATA Brochure/Video Requests
2952 Stemmons Freeway
Dallas, TX 75247

NATA

ALLOW 3 TO 4 WEEKS FOR DELIVERY.

CEU CREDIT QUIZ

Name (Dr., Mr., Mrs., or Ms.) ____________________
Institution or Team ____________________
Mailing Address ____________________
City ____________ State ______ Zip ______
Social Security Number ____________________
NATA Membership Number ____________________

Please indicate below the setting in which you work:

❒ High School ❒ Junior College ❒ College
❒ University ❒ Sports Medicine Center
❒ Other (please specify) ____________________

Instructions

1. Photocopy this page and write on the copy.
2. Read the five articles listed on the previous page.
3. Answer the questions below.
4. Mail with $12 fee (checks made payable to Indiana State University) prior to August 30, 1992, to

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 <u>not</u> 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 contractions and soft tissue stretching in order to invoke the inverse myotatic reflex through stimulating the Golgi tendon organs.
   e. All statements are true.

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

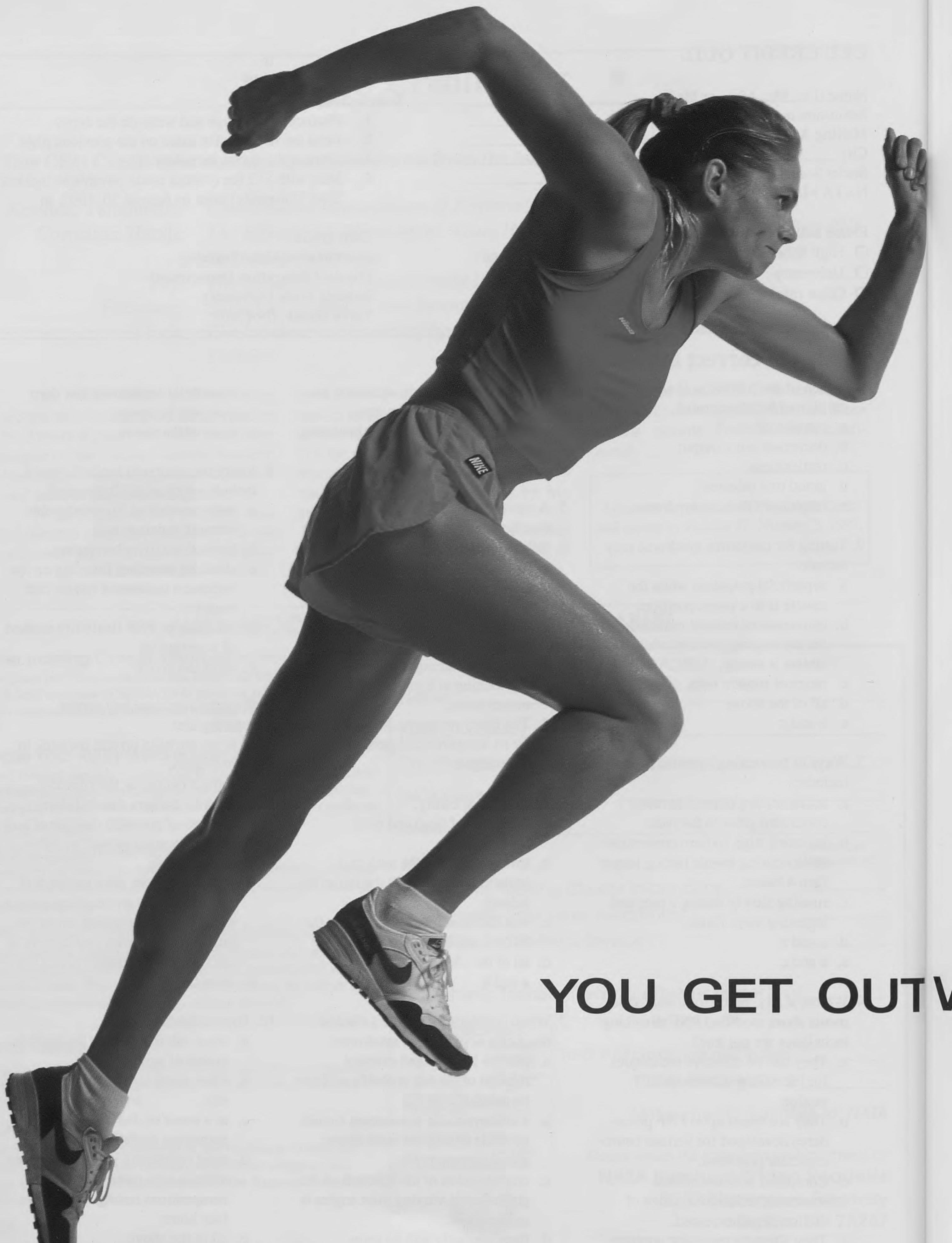
6. Ball carrier spearing:
   a. is a cause of head and neck injuries.
   b. involves flexing the neck and initiating contact with the top of the helmet.
   c. was declared illegal in 1976 by the NCAA and the NFSHSA.
   d. all of the above
   e. a and b

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


NIKE
YOU GET OUTW

Abstracts of 1992 NATA National Convention Free Communications

Sponsored by the NATA Research Committee

Oral Presentations

The Effect of Ice Immersion on Joint Position Sense

LaRiviere JA, Osternig 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 multivariant analysis of variance (MANOVA) revealed no statistically significant difference between conditions, trials, or angles. Additional analyses of variance (ANOVAs) 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 2 ½ min-

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 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 posttreatment 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.

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 Mediums and Their Influence on Muscle Temperature in the Human Leg During Ultrasound Treatments

Draper DO, Sunderland S. Illinois State University, Normal, IL 61761

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 rise (TTR) 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/cm^2 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/cm^2. 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 TTR 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 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 multivariant analysis of variance (MANOVA) indicated no significant differences ($p>.05$) in strength gains (Nm) 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 30.1±9.3), mean EH (27.3±10.9 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)0.5±0.3 vs 0.9±0.3]. Early results indicate that the use of stair climbing compares favorably with cycling in the rehabilitation process of ACL-injured athletes. The effects of stability have not been addressed.

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


The ideal ankle support
is handmade by a professional...
your athletes deserve it.


Nothing fits better. It doesn't come in S, M & L, or "one size fits all"...it's handcrafted by a professional athletic trainer, using quality athletic tape.
The ideal support is designed, and applied to meet a specific need for a specific athlete, using specific athletic tapes.
Johnson & Johnson meets that need with a variety of quality tapes. For product information, phone 1-800-526-3967.
Johnson & Johnson
ATHLETIC PRODUCTS
ZONAS
COACH
ZONAS ELITE
©J&J CPI 1991

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 arthroscope-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 graduate grade point average (GGPA) 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 ($p>.05$) 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

Cormier J, York A, Kegerreis 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

the ATC did not, or should not, participate in the task. Values of two, three, and four represented intermediate levels of involvement. Differences among practices in states with and without ATC licensure were determined by one-way analyses of variance (ANOVAs) for each task. Differences among the three credentials (ATC, PT, PT/ATC) were determined by one-way ANOVAs with Scheffé multiple comparisons for each task. Because of the large number of tests conducted, alpha was set at .01 for each test and for the multiple comparisons. One hundred sixty-nine surveys (40%) were returned by respondents. The mean involvement in current practice ranged from 4.82 for taping and strapping to 1.62 for initial evaluation of non–sports-related spine injuries. The mean opinion of ATCs about their ideal use ranged from 4.98 for taping and strapping to 2.90 for initial evaluation of non–sports-related spine injuries. No significant differences among states with and without ATC licensure were identified for any of the procedures. For 27 of the 28 procedures, there were significant differences in the opinions of individuals with the three credentials about the ideal role of the ATC. Taping and strapping was the only procedure about which the three groups agreed. The multiple comparison procedures revealed that the ATCs' and PTs' opinions were significantly different for 26 of the tasks; the opinions of the ATCs and PT/ATCs were significantly different for 17 of the tasks; and the opinions of the PT/ATCs and PTs were significantly different for only three of the tasks. Conclusions were that licensure does not affect the role of ATCs in SMCs, and that there are marked differences of opinion about the ideal use of ATCs in SMCs among ATCs, PTs, and PT/ATCs. This information is useful to athletic trainers and physical therapists because the two professions must work together to define the role of the ATC that will best benefit the patients in SMCs.

Isokinetic Assessment of Trunk Muscle Strength in Intercollegiate Football Players

Johnson SJ, Freedman AD, Perrin DH. University of Virginia, Charlottesville, VA 22902

Previous studies have focused on isokinetic trunk strength in various populations. No studies have presented isokinetic trunk strength data for intercollegiate football players. The purpose of this study was to develop normative data for the average torque (AT) and peak torque (PT) (Nm) for concentric (CON) and eccentric (ECC) trunk flexion (FL) and extension (EXT) in 38 Division I intercollegiate football players. Subjects were assessed for isokinetic trunk strength via the KinCom dynamometer (Chattecx Corporation) at 15°/sec. Players were divided into two positional groups: Group 1 - backs (N=15, age=19.1 yr, ht=181.0 cm, wt=86.4 kg) and Group 2 - lineman (N=9, age=19.2 yr, ht=192.8 cm, wt=111.5 kg) Height and weight were significantly different ($p<.01$) between the two groups. ECCEXT data on 13 subjects were omitted from the analysis because of velocity errors. Reciprocal muscle group ratios and peak torque to body weight (PTBW) ratios also were calculated. Results indicated that all values for AT and PT were greater in Group 2 than in Group 1. The CON and ECC values were greater for EXT than for FL for both groups. There was a significant difference ($p<.01$) in CONFLAT and ECCFLAT between groups (1CONFLAT=115.2 Nm vs 2DONFLAT =164.6 Nm; 1ECCFLAT=130.4 Nm vs 2ECCFLAT=188.2 Nm). CONFLPT and ECCFLPT values followed the same pattern as the AT values. Reciprocal muscle group ratios were also significantly different between groups for CON strength values (1CONFL/EXT=5.1 vs 2CONFL/EXT=.64). No significant differences were found in the PTBW ratios between the two groups. This study establishes strength values and reciprocal muscle group ratios for the trunk in intercollegiate football players. The study also suggest that the strongest members of this population exceed the isokinetic force limits of the KinCom dynamometer during assessment of trunk extension.

Peak Torque Reliability of Biodex B-2000 Isokinetic Dynamometer During Concentric Loading of Back Flexors and Extensors

Hoffert T, Kimura I. Temple University, Philadelphia, PA 19103

The purpose of this study was to assess the reliability of the Biodex isokinetic dynamometer in the measurement of peak torque during concentric loading of the back flexors and extensors. The back muscles of 30 asymptomatic male Temple University volunteers, who had no previous experience with the Biodex back apparatus, were tested in a 100° arc using the concentric mode of the Biodex B-2000 isokinetic dynamometer. Following a warm-up of four submaximal repetitions and one maximal repetition, the subjects performed a five repetition test bout at 90°/sec. The three testing sessions, conducted on different days, consisted of practice, test, and retest sessions. The subjects were retested following a rest period of at least 7 days and not more than 10 days. The reliability between test and retest was evaluated by performing a repeated measures analysis of variance with reliability. Correlation coefficients for trunk flexion and extension were $r=0.74$ and $r=0.87$, respectively. Cronbach's alpha levels for trunk flexion and extension were .843 and .931, respectively. Results of the study revealed a high positive correlation between test and retest sessions. Recommendations for further study include: (1) increasing the number of practice and data collection sessions; (2) testing at velocities other than 90°/sec; and (3) increasing the sample size.

Intraclass Reliability Estimates for Concentric Muscle Testing With a Kin Com 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 (ANOVAs) to analyze differences among and within subjects and to calculate ICCs. No significant differences were

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. Intraclass 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 (ANOVAs), 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 scotch 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, 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 scotch cast, fiberglass, orthoplast, and felt materials. The 1-inch foam absorbed significantly more force ($p<0.05$) than the fiberglass, felt, forearm pad, and scotch 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.

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 "lean" 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 lean" 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 then was connected to a monitor. Fifteen milliliters of ultrasound gel preheated to body temperature (37°C) was applied to a target area 10cm in diameter. Continuous ultrasound was delivered topically at 1.5 W/cm^2 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 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 ($p>.05$) 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 (ANOVAs) 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 plantar 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 Scheffé 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.

Effects of Adhesive Spray and Prewrap on Taped Ankle Inversion Before and After Exercise

Keetch 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, Horiuchi 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 flexor and extensor muscles in recreational athletes. Twenty females (age=26.0±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 (ANOVAs) 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 Intercollegiate 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 correlations 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, Sitler 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 (ANOVAs) 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 suggest 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.

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 multivariant 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, Chattecx 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>.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 endoligamentous 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.

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, a 15-year-old female softball pitcher, and a 20-year-old male baseball player. All patients had nondescript 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

Schack F, Pettrone 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 athletic 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. Despite the level of nutrition knowledge, the athletes were aware of two basic concepts to maintain their weight: increasing carbohydrate intake by eating pasta, breads, and cereals, and decreasing fat intake by consuming less meat, eggs, whole milk products, butter, margarine, and heavy dressings. 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.

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

Percent Body Fat and Regional BMD in Subgroups of Track Athletes

			BMD (g/cm^2)		
	%Fat †	L 2-3 *§	Pelvis*§	Ward's *	Legs *
Throwers (T)	31.0	0.87	1.35	1.21	1.34
Sprinters (S)	19.5	0.99	1.32	1.22	1.37
Runners (R)	20.1	0.70	1.11	1.03	1.23

* T>R, $p \leq 0.05$
† T>R&S, $p \leq 0.05$
§ S>R, $p \leq 0.05$

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, $p\leq0.01$), 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 7, 8, and 10 (excluding Canadian schools) that are listed in the National Collegiate Athletic Association directory. We requested that the survey be completed by the head athletic trainer and one assistant athletic trainer. Surveys were mailed to 162 institutions; one school returned the surveys stating that they did not employ athletic trainers. From the remaining 161 colleges and universities, we received 105 responses from 75 institutions for a 46% return rate. Results indicated that the majority of the respondents' positions are funded by the athletic department with many funded dually through the athletic and physical education departments. Most athletic trainers are hired and supervised by the athletic director. The majority of head athletic trainers earn \$31 000 per year with a large percentage making over \$40 000. The majority of assistant athletic trainers earn \$25 000 or less per year. Not surprisingly, the vast majority of the respondents worked more than 50 hours per week. One of the original interests of the researchers in this study was to determine if there was a better employment situation that the athletic trainers could negotiate for themselves when they were offered a position. There were 22 people reporting that they did not have a written job description. In the written comments section, these people stated that a written job description would enhance their working conditions. Other people stated that even though they have a written job description, their supervisor sometimes requires them to perform duties not outlined in the current document. It appears evident from this data that there are many different employment parameters for athletic trainers. We think that more research is needed to present a complete picture of the characteristics of employment for collegiate athletic trainers.

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.

Rank Order of Entry-level Annual Salaries for Athletic Trainers, 1990 through 1992, According to Job Descriptions

Job Description	Annual Salary	n
1. High School Athletic Trainer/Teacher	28,068 *	26
2. College/University Athletic Trainer/Teacher	25,833	9
3. Clinic Athletic Trainer	24,183	8
4. Clinic Athletic Trainer/High School	23,474	37
5. College/University Head Athletic Trainer	22,126	9
6. High School Athletic Trainer	21,600	1
7. College/University Assistant Athletic Trainer	21,162 *	16

* $p<0.05$

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 Acreditation (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.

An Overview of Selected State Licensure Athletic Training Laws

Gary E. Morin, MS, ATC

ABSTRACT: With the growth of athletic training, many state governing bodies have created regulations concerning the role of athletic trainers in their respective states. Some of these states have included the licensure, certification, and/or registration of athletic trainers as a prerequisite for employment. 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.

Gary Morin is an assistant athletic trainer and assistant professor with the Deparment of Physical Education at Southern Connecticut State University in New Haven, CT.

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 (20)." 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 (9, 13,20,30,31).

The NATA certification examination of athletic trainers is recognized by all of the states except Texas (32), which does not accept it as a means to be licensed in Texas. New Mexico (24) uses the NATA's standards of practice and its established competencies as part of its athletic training licensing requirements. Missouri (17) 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 and professional athletic organizations (1,3,5, 13,17,20,30). Oklahoma (27) restricts athletic trainers to practice with educational institutions and amateur organizations, excluding professional organizations. These restrictions reflect the traditional setting of the athletic trainer and do not recognize the athletic trainer's 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(25) and Delaware (33) expressly permit the athletic trainer to work in a private clinical situation. 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 (18). Delaware (33) 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 (25) 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 (30) and New Mexico (24) require that the physician's standing

Table 1.—Departmental Addresses of States that Require Certification, Licensure, or Registration for Athletic Trainers (Source: NATA, Stemmons Drive, Dallas,TX)

DELAWARE Board of Athletic Trainers O'Neal Building PO Box 1401 Dover, DE 19903	MISSOURI MO State Board for the Healing Arts PO Box 4 Jefferson City, MO 65102	PENNSYLVANIA Bureau of Professional & Occupational Affairs PO Box 2649 Harrisburg, PA 17105
GEORGIA GA Board of Athletic Trainers 166 Pryor Street, SW Atlanta, GA 30303	NEBRASKA State Bureau of Examining Boards PO Box 95007 Lincoln, NE 68509	RHODE ISLAND RI Dept of Health Professional Regulations 75 Davis Street, Room 104 Providence, RI 02908
IDAHO ID State Board of Medicine 208 North 8th Street #202 State House Boise, ID 83720	NEW JERSEY Board of Medical Examiners 28 West State Street Trenton, NJ 08608	SOUTH CAROLINA Dept of Health and Environmental Control 2600 Bull Street Columbia, SC 29201
ILLINOIS Dept of Professional Examiners 302 W Washington, Third floor Springfield, IL 62786	NEW MEXICO Dept of Regulation/Athletic Trainers PO Box 25101 Sante Fe, NM 87540	SOUTH DAKOTA SD Board of Medical Examiners 1323 S Minnesota Avenue Sioux Falls, SD 57005
KENTUCKY KY Board of Medical Licensure Mall Office Center 400 Sherburn Lane, Suite 222 Louisville, KY 40207	NORTH DAKOTA Joe Kroeber, ATC 1210 7th Avenue, SE Jamestown High School Jamestown, ND 58401	TENNESSEE Board of Medical Examiners State Dept of Health Ben Allen Road Nashville, TN 37216
LOUISIANA LA State Board of Medical Examiners 830 Union Street, Suite 100 New Orleans, LA 70112	OHIO Rachael Mallory OH Board of Athletic Training 77 S High Street 16th floor Columbus, OH 43266	TEXAS TX Dept of Health Bureau of Licensing and Certification State Board of Athletic Trainers 1100 West 49th Street Austin, TX 78756
MASSACHUSETTS Board of Allied Professions State Office Building, 15th floor 100 Cambridge Street Boston, MA 02202	OKLAHOMA OK State Board of Medical Examiners PO Box 18256 Oklahoma City, OK 73154	

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

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) 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). Gen-

Table 2.—Athletic Trainer Licensure by Endorsement

A - NATA-certified
B - NATA-certified from accredited program
C - NATA-certified and additional coursework (from non-approved programs)
D - NATA-certified and additional coursework (from approved programs)
E - Licensed by another state

	A	B	C	D	E
Delaware	Yes	-	-	-	Yes
Georgia	-	Yes	Yes	-	Yes
Idaho	Yes	-	-	-	No
Illinois	-	Yes	Yes	-	Yes
Kentucky	-	Yes	Yes	-	Yes
Louisiana	-	Yes	Yes	-	Yes
Massachusetts	-	Yes	Yes	-	Yes
Missouri	Yes	-	-	-	Yes
Nebraska	Yes	-	-	-	Yes
New Jersey	Yes	-	-	-	Yes
New Mexico	-	Yes	Yes	-	Yes
North Dakota	Yes	-	-	-	Yes
Ohio	Yes(1)	-	-	-	Yes
Oklahoma	Yes	-	-	-	Yes
Pennsylvania	-	Yes(2)	Yes(2)	Yes(3)	Yes(2)
Rhode Island	-	Yes	Yes	-	Yes
South Carolina	Yes	-	-	-	Yes
South Dakota	Yes	-	-	-	Yes
Tennessee	Yes(1)	-	-	-	Yes
Texas(4)	No	No	No	No	No

(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.

Table 3.—Partial List of Required Coursework Necessary to Obtain State Licensure (included if listed in materials returned with the survey)

Coursework	State
Anatomy	IL, KY, MA(2), MO, OH, RI, SD, TN, TX
Physiology	IL, MA, OH, RI, SD, TN, TX
Exercise Physiology	IL, KY, MA, MO, OH, RI, SD, TX
Kinesiology/Applied Anatomy	IL, KY, MA, MO, OH, RI, SD, TN, TX
Psychology	IL(2), MO, OH(2), RI(2), SD
First Aid	IL, KY, MA, MO, OH, RI, SD, TN, TX
CPR	IL, KY, MA, OH, RI, SD, TN, TX
Nutrition	IL, KY, MA, MO, OH, RI, SD, TN
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.

erally, to obtain Class A certification, applicants must have graduated from a program preapproved by the Pennsylvania Board of Physical Therapy or attend classes and complete extra coursework (3). Class B aspirants must be NATA-certified and must have graduated from an NATA-approved or equivalent program (3).

Many states have established minimum levels of clinical and nonclinical hours that are required to secure state licensure. Many states follow the NATA guidelines of 800 hours in approved programs and 1500 hours in internship programs (8). Idaho (9) requires 1000 hours of internship experience, with 800 in the traditional setting and the remainder in an allied health setting. Texas (32) sets a minimum of 600 hours per year for 3 years for a total of 1800. Georgia (6) established a standard of at least 600 hours per year for 4 years or 2400 total hours. Some states allow physical therapists to obtain licensure as an athletic trainer after completing a reduced number of clinical hours. Louisiana (14) and Texas (32) permit licensure after 720 hours over a 2-year period.

Individual states also have regulations unique to their state. Texas (32), Missouri (17), and Ohio (25,26) require that applicants be residents of the state or primarily employed in the state. As mentioned earlier, Missouri (17) requires applicants to file a physician's protocol with the state board upon application.

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 licensure, 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.

Many states acknowledge the existence of the student and/or intern athletic trainer. Very often, little regulation is applied, except for the proper supervision by a licensed athletic trainer (1,5,9,14, 19,21,32). Louisiana (14) requires a 3:1 ratio of student athletic trainers to licensed athletic trainer, which contrasts with NATA (8) established guidelines for approved programs. These require an 8:1 ratio of student athletic trainers to certified athletic trainer. Oklahoma (27,28) appears to be the only state that mandates the licensing of student or intern athletic trainers with the state board, although no exam is necessary at present. Ohio (25) directs that those individuals serving as student athletic trainers must do so with the intent of becoming a certified and/or licensed athletic trainer. Idaho (9) permits those studying to become an athletic trainer to obtain a provisional athletic training license for up to 2 years.

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.

References

1. Athletic Trainers' Act of South Carolina (June 19, 1984), 441, ch 75, § 44-75-10 to -100.
2. Campbell D. Governmental affairs committee. *NATA News*. 1991; 3: 7.
3. 49 Pa Code § 40.71-75, .81-87, .101-103, .121, .131 (1988).
4. 4 Mo Code, ch 6 § 150-6.010 to -6.050 (as amended May 3, 1985).
5. Ga Rul & Regs, ch 53 § 53-1 to -9 (1989).
6. Ga Code Ann, ch5 § 43-5-1 to -15 (as amended 1989).
7. Godek J. Athletic training and physical therapy APTA-NATA task force progress report. *NATA News*. August 1991; 3: 5.
8. Guidelines for the Development and Implementation of NATA Approved Undergraduate Athletic Training Education Programs. NATA Professional Education Committee, Fall 1988.
9. Idaho Code § 54.3901-.3918 (as amended 1989 ch.179 s 1, 441).
10. Ill Athletic Trainers' Practice Act, Regs, tit 68, ch VII (b) § 1160.10-.80.
11. Instructions for Athletic Trainer Certification. Tenn Bureau of Manpower and Facilities, Health Related Boards, April 1991.
12. Kent Rev Stat § 311.900-.928 (1979).
13. La Athletic Trainer's Act, Rev Stat § 37.301-.3312 (1985).
14. La Reg, tit 46, ch 31, 57 § 3101-3161, 5701-5723 (August 1986).
15. Lawrence G. Athletic trainers' duties clarified. *Conn Sportsmed*. January 1991; 18: 1.
16. Mass Act of 1982, ch 67, 1545-1546.
17. Mo Athletic Trainers Practice Act, ch 334 § 334.700-725 (1989).
18. NCAA legislative services: state legislature relating to athletics. *NCAA News*. May 1991; 28: 23.
19. Neb Code Regs, tit 172, ch 17 § 001-011 (1986).
20. Neb Rev Stat § 71-1, 238-, 243.
21. NJ Athletic Training Practice Act, Pub L 1984, ch 203 § 37.40-.45 (1984).
22. NJ Pub L 1984, ch 203 § 37.40-.45 (amended Oct. 27, 1988).
23. NJ Pub L 1984, ch 203 § 37.40-.45 (amended May 4, 1989).
24. NM Reg AT-01-09 § 100-600 (1989).
25. Ohio Act of March 29, 1990, Rev Code Stat § 4755.03, .60-.65.
26. Ohio Exec Order No 91-49V, Rev Code ch 119 § 4755.42.02, -43-01, -43-02, -05, -07, -10, -44-01, -02 (Apr. 8, 1991).
27. Okla Athletic Trainers' Act, tit 59, § 525-535.
28. Okla Med Pract Act, ch XIII § A-H, 28-32.
29. RI Gen L, ch 60 § 50-60-01 to -05, -08 to -19 (1956, as amended June 1988).
30. SD Adm Rule § 20: 63: 01-: 05, 1-7 (1991).
31. SD Codified L § 36-29-1 to-30, 213-221.
32. Tex Civ Stat § 313.2-.17 (1971).
33. 24 Del ch 26 § 2601-2616.
34. 259 Mass Code Req, vol 12, 1.00. 2.00. 4.00.

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 iis 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).

Fig 1.—Stabilize the head and neck.

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

Leah Putman is director of the Athletic Training Education Program at New Mexico State University in Las Cruces, NM.

Audio & Video Cassettes
of the
NATA 42ND Annual Meeting & Clinical Symposium

Selected sessions of the 1991 NATA Annual Meeting and Clinical Symposium are available on audio and video tapes from AVW Audio Visual, Inc. You can order these cassettes by mailing or faxing the order form with payment to AVW at the address below. Six-pack and 12-pack cassette binders available at the prices listed below. Please indicate the quantity desired in the appropriate area. Don't delay....Order Today!

NAME OF SEMINAR	AUDIO	VIDEO
AOSSM Seminar: Shoulder Injuries in Athletics: Recognition, Care, and Rehabilitation	☐ NATA01....$20.00	
McNeil Symposium	☐ NATA02....$17.00	
PFATS Seminar: Risk Reduction and Management: The Best Offense is a Good Defense	☐ NATA03....$17.00	
PBATS Seminar: The Dangers of Smokeless Tobacco Use in Athletics	☐ NATA04....$17.00	
Keynote Address	☐ NATA05....$ 8.50	☐ NATA05V....$20.00
Manual Therapy Techniques in the Training Room	☐ NATA06....$ 8.50	☐ NATA06V....$20.00
Inertial Exercise: Principles and Applications	☐ NATA07....$ 8.50	☐ NATA07V....$20.00
Management of a Sports Clinic	☐ NATA08....$17.00	☐ NATA08V....$20.00
Manual Therapy Overview: Sacro-Iliac Joint Lumbar Dysfunction	☐ NATA09....$ 8.50	☐ NATA09V....$20.00
Ergogenic Aids	☐ NATA10....$ 8.50	☐ NATA10V....$20.00
Myofascial Release Techniques	☐ NATA11....$ 8.50	☐ NATA11V....$20.00
Elbow Injuries: Mechanics, Evaluation, and Rehabilitation	☐ NATA12....$17.00	
Research Presentations	☐ NATA13....$17.00	
High School Athletic Trainers' Seminar	☐ NATA14....$17.00	
Legal Aspects of Catastrophic Injury	☐ NATA15....$17.00	☐ NATA15V....$20.00
Dealing With Catastrophic Injury or Death of Your Athlete	☐ NATA16....$ 8.50	☐ NATA16V....$20.00
Case Studies	☐ NATA17....$ 8.50	☐ NATA17V....$20.00
Tendon: Function, Anatomy, Injury, Management, and Rehabilitation	☐ NATA18....$ 8.50	☐ NATA18V....$20.00
Updating Ankle Injuries	☐ NATA19....$ 8.50	☐ NATA19V....$20.00
Low Back Pain in Athletics	☐ NATA20....$17.00	☐ NATA20V....$20.00
Clinical Athletic Trainers' Workshop	☐ NATA21....$34.00	
An Update on Medical Ethics	☐ NATA22....$17.00	
Pioneer Women in Athletic Training	☐ NATA23....$17.00	
How To Market Yourself to Your Employers	☐ NATA24....$17.00	
FREE COMMUNICATIONS — Duncan, Ray, Timm, Black	☐ NATA25....$ 8.50	
FREE COMMUNICATIONS — Russell, Guskiewicz, Dolan, Pressly	☐ NATA26....$ 8.50	
FREE COMMUNICATIONS — Perrin, Meyers, McLaughlin, Steele	☐ NATA27....$ 8.50	
FREE COMMUNICATIONS — Lephart, Johnson	☐ NATA28....$ 8.50	
FREE COMMUNICATIONS — Cramer, Draper, Reynolds, Hellwig	☐ NATA29....$ 8.50	
FREE COMMUNICATIONS — Woodhouse, Moffatt, Cavanaugh, Roncarati	☐ NATA30....$ 8.50	
FREE COMMUNICATIONS — Harrelson, Lepp, Martin, Wilkerson	☐ NATA31....$ 8.50	
FREE COMMUNICATIONS — Dolk, Fisher, Scotch	☐ NATA32....$ 8.50	
Androgenic Anabolic Steroids: An Update	☐ NATA33....$ 8.50	
Brachial Plexus Injuries	☐ NATA34....$ 8.50	☐ NATA34V....$20.00
Athletes at Risk	☐ NATA35....$ 8.50	☐ NATA35V....$20.00
Psychology of the Injured Athlete	☐ NATA36....$ 8.50	☐ NATA36V....$20.00

NAME ____________________

ADDRESS ____________________

CITY/STATE/ZIP ____________________

PHONE ____________________

METHOD OF PAYMENT: AMEX VISA MC CHECK
(circle one)

CARD# ____________________

EXPIRATION DATE ____________________

SIGNATURE ____________________

TOTAL FOR TAPES ORDERED.................... $ ________
("V" indicates Video Tape)

TOTAL FOR AUDIO TAPE BINDERS ORDERED
__ 6 Pk. @ $5.00 __ 12 Pk. @ $7.00.......... $ ________

SHIPPING & HANDLING
$3.50 USA or $6.00 International............ $ ________

TX RESIDENTS: Add 8.5% Sales Tax............ $ ________

TOTAL.. $ ________

PLEASE ALLOW 2 TO 3 WEEKS FOR DELIVERY

Make checks payable to: **AVW AUDIO VISUAL, INC.**
2233 Irving Blvd. • Dallas, TX 75207
(214) 638-0024 • FAX (214) 631-5238

11/1/91

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.

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).

Acknowledgements

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

References

1. Arnheim DD. *Modern Principles of Athletic Training*. 7th ed. St. Louis, Mo: Times Mirror/Mosby Co; 1989: 254-255.
2. Booher JM, Thibodeau GA. *Athletic Injury Assessment*. 2nd ed. St. Louis, Mo: Times Mirror/Mosby Co; 1989: 242-243.
3. Denegar CR, Saliba E. On field management of the potentially cervical spine injured football player. *Athletic Training, JNATA*. 1989; 24: 108-111.
4. Drowatzky, JN. Legal duties and liability in athletic training. *Athletic Training, JNATA*. 1985; 20: 10-12.
5. Hillman S. Roles and responsibilities in an emergency situation. Presented at the NATA District 7 Meeting; March 16, 1991; Phoenix, Ariz.
6. Mellion MB, Walsh WM, Shelton GL. *The Team Physician's Handbook*. Philadelphia, Pa: Hanley & Belfus Inc; 1990: 129, 286.
7. Nelson WE, Geick JH, Jane JA, Hawthorne, P. Athletic head injuries. *Athletic Training, JNATA*. 1984; 19: 95-100.
8. Roy S, Irvin R. *Sports Medicine: Prevention, Evaluation, Management, and Rehabilitation*. Englewood Cliffs, NJ: Prentice-Hall; 1983: 81-82, 257.
9. Torg, JS. *Athletic Injuries to the Head, Neck, and Face*. 2nd ed. St. Louis, Mo: Mosby Year Book; 1991: 432-434.
10. Wilkerson, GB. Cervical immobilization of a football player on a scoop stretcher. *Athletic Training, JNATA*. 1983; 18: 207-208.

A Look at the Components and Effectiveness of Sports Drinks

Jennifer Smith, ATC, LAT

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).

Jennifer Smith is an athletic trainer with Associated Physical Therapy in Plano, TX.

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 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).

Solutes 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 shrunken 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 ultraendurance 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 know as maltodextrins), are added to the sports drinks on the market. Each are included according to the main purpose of the drink, ie, 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 are 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

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

Special thanks to Jeff Crumbaugh, Annette Peel, Gary Strickland, Bill Tuscany, and Karen Lindberg for their assistance.

References

1. Applegate L. Fueling. *Triathlete.* July 1980; 31-36.
2. Coleman E. Sports drink update. *Gatorade Sports Science Institute.* 1988; 1.
3. Costill DL, Saltin B. Factors limiting gastric emptying during rest and exercise. *J Appl Physio.* 1974; 37: 679.
4. Exceed: Exceed Sports Nutritionals. Columbus, Ohio: Ross Laboratories; April 1990.
5. Flynn MG, Costill DL, Hawley JA, et al. Influence of selected carbohydrate drinks on cycling performance and glycogen use. *Med Sci Sports Exerc.* 1987; 19: 37-40.
6. Foster C, Costill DL, Fink WJ. Gastric emptying characteristics of glucose and glucose polymer solutions. *Res Q.* 1980; 31: 299-305.
7. Gatorade Sports Science Institute. The Science of Gatorade. Indianapolis, Ind: Quaker Oats Company. 1990.
8. Ivy J, Costill DL, Fink WJ, Lower RW. Influence of caffeine and carbohydrate feedings on endurance performance. *Med Sci Sports Exerc.* 1979; 11: 6-11.
9. Ivy JL, Mill W, Dover V, Goodyear LG, Sherman WM, Farrell S, William H. Endurance improved by ingestion of a glucose polymer supplement. *Med Sci Sports Exerc.* 1983; 15: 466-471.
10. Mitchell JB, Costill DL, Houmard JA, Flynn MG, Fink WJ, Beltz JD. Effects of carbohydrate ingestion on gastric emptying and exercise performance. *Med Sci Sports Exerc.* 1988; 20: 110-115.
11. Murray R. Fluid replacement, gastrointestinal function, and exercise. *Athletic Training, JNATA.* 1988; 23: 215-219.
12. Murray R. The effects of consuming carbohydrate-electrolyte beverages on gastric emptying and fluid absorption during and following exercise. *Sports Med.* 1987; 4: 322-351.
13. Seiple, RS, Vivan VM, Fox EL, Bartles RL. Gastric-emptying characteristics of two glucose polymer electrolyte solutions. *Med Sci Sports Exerc.* 1983; 15: 366-369.
14. Snape WJ, Suchowiecky M. Nutrients and gastric emptying. *Nutr MD.* 1986.
15. Tortora GJ, Anagnostakos NP. *Principles of Anatomy and Physiology.* New York, NY: Harper and Row; 1987: 608-609.
16. Wahren JG, Ahlborg G, Felig P, Jorfeldt L, Glucose metabolism during exercise in man. In: Pemow B, Saltin B. eds. *Muscle Metabolism During Exercise: Proceedings of a Karolinska Institute Symposium.* New York, NY: Plenum Press; 1971: 189-204.
17. William MH. *Nutritional Aspects of Human Physical and Athletic Performance.* Springfield, Ill: Charles C. Thomas; 1985: 79, 187-194, 226-233.

Management and Treatment of a Mandible Fracture in an Athlete

Jerry Koloskie, MS, ATC
Daniel L. Orr, PhD, DDS

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.

Jerry Koloskie is the head athletic trainer at the University of Nevada in Las Vegas, NV.

Daniel Orr is an associate professor of surgery at the University of Nevada Medical School.

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 parasymphaseal 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

Fig 1.—Parasymphaseal fracture of the mandible

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.

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.

At 3 ½ 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 the occasional use of training elastics and a form-fitted mouthpiece was implemented gradually about 4 weeks after surgery (6). 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 4½ 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, zygomaticomaxillary 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, ramus, 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 nerve (V); facial paralysis secondary to trauma to the facial nerve (VII); malocclusion; compromised nasal or oral airway function; intraoral, extra-oral, or intra-aural ecchymoses; avulsions, lacerations, etc.; or frank loss of form and/or crepitation of bones to palpation (1,3).

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

1. Archer H. *Oral and Maxillofacial Surgery*. Philadelphia, Pa: WB Saunders; 1975: 1204-1209.
2. Dodson T, Perrott D, Kaban L, Gordon N. Fixation of mandibular fractures, a comparative analysis of rigid internal fixation and standard fixation techniques. *J Oral Maxillofac Surg*. 1990; 362-366.
3. Haskell R. Applied surgical anatomy. In: Rowe NL, Williams JL: *Maxillofacial Injuries*. New York, NY: Churchill Livingstone; 1985: 1-42.
4. Landtwing K. Evaluation of the normal range of vertical mandibular opening in children and adolescents with special reference to age and stature. *J Oral Maxillofac Surg*. 1978; 6: 157-162.
5. Matthews B. Maxillofacial trauma from athletic endeavors. *Athletic Training, JNATA*. 1990; 25: 132-137.
6. Morrow R, Bonci T. A survey of oral injuries in female and university athletes. *Athletic Training, JNATA*. 1989; 24: 236-237.
7. Peterson M, Peterson K. *Eat to Compete*. Chicago, Ill: Year Book Medical Publishers; 1988: 148-167.
8. Zide M, Kent J. Indications for open reduction of mandibular condylar fractures. *J Oral Maxillofac Surg*. 1983; 41:89.

A Survey of Athletic Medicine Outreach Programs in Wisconsin

Steven J. Nass, PT, ATC, REMT

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 agreements, 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).

Steven Nass is a clinical physical therapist and outreach athletic trainer at the University of Wisconsin Hospital Sportsmedicine Center in Madison, WI.

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 canvasing, 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.

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

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

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

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

Service	No. Offering
Strength Testing	
Isokinetic	16
Isotonic	6
Isometric	7
Flexibility	18
Body Composition	15
Aerobic Capacity	3
Anaerobic Capacity	2
Nutritional Advice	8
Other--one each: Medical History, Specific Sports Counseling, Pre-season Exams, Orthopedic Screening	

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 freestanding 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 WIS STAT §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

1. Black SA. Marketing rehab through high school athletic training services. *Rehab Management.* August-September 1991; 4: 50-51.
2. Bloomberg R. Trainers for high school athletes: Seattle develops a model program. *Phys Sportsmed.* November 1989; 9: 113-119.
3. Culpepper MI. The availability and delivery of health care to high school athletes in Alabama. *Phys Sportsmed.* January 1986; 14: 131-137.
4. Eischen CG. Ronald Peyton lectureship award. *J Orthop Sports Phys Ther.* December 1989; 11: 224-226.
5. Garrick JG, Requa R. Medical care and injury surveillance in the high school setting. *Phys Sportsmed.* February 1981; 9: 115-120.
6. Gould JA. Physicians, physical therapists, and athletic trainers: teammates in health care for the injured athlete. *J Orthop Sports Phys Ther.* August 1989; 11: 47-48.
7. Hermann DE. Minutes of the April 6, 1989 meeting of the Wisconsin Interscholastic Athletic Association.
8. Hossler P. How to acquire an athletic trainer on the high school level. *Athletic Training, JNATA.* 1985; 20: 199-203, 228-229.
9. National Athletic Trainers' Association. Study shows 23% of high school basketball players injured. *NATA News.* January 1988; 1: 15-16.
10. National Athletic Trainers' Association. High school injury studies prove "meaningful, of public interest." *NATA News.* January 1989; 2: 6-7.
11. National Athletic Trainers' Association. NATA adjusting to "non-traditional" ATCs. *NATA News.* January 1989; 2: 9.
12. National Athletic Trainers' Association. NATA and APTA leaders consider forming a joint task force. *NATA News.* April 1990; 2: 6.
13. Porter M, Noble B, Bachman D, Hoover R. Sportsmedicine care in Chicago-area high schools. *Phys Sportsmed.* February 1980; 8: 95-99.
14. Prentice WE, Mishler B. A national survey of employment opportunities for athletic trainers in the public schools. *Athletic Training, JNATA.* 1986; 21: 215-219.
15. Ray R. A survey of Michigan school superintendents' knowledge of and attitudes toward athletic injuries, athletic trainers, and legal liability. *Athletic Training, JNATA.* 1987; 22: 311-315.
16. Redfearn RW. Are high school athletes getting good heath care? *Phys Sportsmed.* August 1975; 2: 34-38.
17. Redfearn RW. Emergency medical skills in high school coaches. *Phys Sportsmed.* November 1980; 8: 115-116.
18. Redfearn RW. The physician's role in school sports programs. *Phys Sportsmed.* September 1980; 8: 67-71.
19. Rice SG. Is athletic health care a primary concern in secondary schools? *Phys Sportsmed.* March 1985; 13: 169-172.
20. Rowe JP, Robertson DM. Knowledge of care and prevention of athletic injuries in high schools. *Athletic Training, JNATA.* 1986; 21: 116-119.
21. Sherman B. A new approach to athletic training in southern Wisconsin high schools. *Phys Sportsmed.* January 1985; 13: 57-64.
22. Smith D, ed. Roles and relationships of the sports physical therapist and the certified athletic trainer. *Sports Physical Therapy Section Newsletter.* 1990; 8: 4-5.
23. Strauss, RH. ed. Sports medicine directory 1987. *Phys Sportsmed.* September 1987; 13: 221-238.
24. Wisconsin Interscholastic Athletic Association. *Directory of Member Schools.* Stevens Point, Wis: WIAA; 1989-90: 3-61.
25. Wisconsin Physical Therapy Association. Direct access is state law. *Legislative Times.* August-September 1989; 2: 1.
26. Wisconsin Physical Therapy Association. *WPTA Directory.* Madison, Wis: WPTA; 1989-90: 4-34.
27. Yeager B. Medical care for young athletes: pretty barbaric, but that's the way it is. *Phys Sportsmed.* November 1974; 2: 75-81.

Book Review

Phil Callicutt, EdD, ATC

Sequence Exercise
Hans Gunnari, Olaf Evjenth, and
M. Michael Brady
Dreyer Press, Oslo, Norway
Distributed in the U.S. by
OPTP
PO Box 47009
Minneapolis, Minn 55447-0009
1984
151 pages, Illustrated

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 Thorndike, 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.

Current Literature

Body Composition/Weight Loss

Astrup A, Quaade F. Very low calorie diet compliance and lean body mass. *Int J Obes*. 1989; 13(suppl 2): 27-31.

Ballor DL, McCarthy JP, Wilterdink EJ. Exercise intensity does not affect the composition of diet- and exercise-induced body mass loss. *Am J Clin Nutr*. 1990; 51: 142-146.

Bunt JC, Lohman TG, Boileau RA. Impact of total body water fluctuations on estimation of body fat from body density. *Med Sci Sports Exerc*. 1989; 21: 96-100.

Campaigne BN. Body fat distribution in females: metabolic consequences and implications for weight loss. *Med Sci Sports Exerc*. 1990; 22: 291-297.

Cavallo E, Armellini F, Zamboni M, Vicentini R, Milani MP, Bosello O. Resting metabolic rate, body composition and thyroid hormones: short-term effects of very low calorie diet. *Horm Metab Res*. 1990; 22: 632-635.

Clifford PA, Tan SY, Gorsuch RL. Efficacy of a self-directed behavioral health change program: weight, body composition, cardiovascular fitness, blood pressure, health risk, and psychosocial mediating variables. *J Behav Med*. 1991; 14: 303-323.

Coxon A, Kreitzman S, Brodie D, Howard A. Rapid weight loss and lean tissue: evidence for comparable body composition and metabolic rate in differing rates of weight loss. *Int J Obes*. 1989; 13(suppl 2): 179-181.

Dalle Grave R, Bussinello P, Zeni A. Short-term effect of a very low calorie diet on body compositon and fat distribution. *Int J Obes*. 1989; 13(suppl 2): 177-178.

Deurenberg P, Weststrate JA, Hautvast JG. Changes in fat-free mass during weight loss measured by bioelectrical impedance and by densitometry. *Am J Clin Nutr*. 1989; 49: 33-36.

Deurenberg P, Weststrate JA, van der Kooy K. Body composition changes assessed by bioelectrical impedance measurements. *Am J Clin Nutr*. 1989; 493: 401-403.

Elliot DL, Goldberg L, Kuehl KS, Bennett WM. Sustained depression of the resting metabolic rate after massive weight loss. *Am J Clin Nutr*. 1989; 49: 93-96.

Estok PJ, Rudy EB, Just JA. Body-fat measurements and athletic menstrual irregularity. *Health Care Women Int*. 1991; 2: 237-248.

Forbes GB. Exercise and body composition. *J Appl Physiol*. 1991; 70: 994-997.

Foster GD, Wadden TA, Feurer ID, Jennings AS, Stunkard AJ, Crosby LO, Ship J, Mullen JL. Controlled trial of the metabolic effects of a very low calorie diet: short- and long-term effects. *Am J Clin Nutr*. February 1990; 51: 167-172.

Hawks SR. Exercise and weight loss: the uncertain connection. *Health Educ*. August 1989; 20: 11-15.

Hill GL. Some implications of body composition research for modern clinical management. University Department of Surgery, Auckland Hospital, New Zealand. *Infusionstherapie*. April 1990; 17 (suppl 3): 79-80.

Horswill CA, Park SH, Roemmich JN. Changes in the protein nutritional status of adolescent wrestlers. *Med Sci Sports Exerc*. 1990; 22: 599-604.

Kreitzman SN. Lean body mass, exercise and VLCD. *Int J Obes*. 1989; 13(suppl 2): 17-25.

Kreitzman SN, Coxan A. The use of electrical impedance and infra-red interactance to determine non-water lean component of fat-free mass. *Basic Life Sci*. 1990; 55: 433-435.

Lemons AD, Kreitzman SN, Coxon A, Howard A. Selection of appropriate exercise regimens for weight reduction during VLCD and maintenance. *Int J Obes*. 1989; 13(suppl 2): 119-123.

Melby CL, Schmidt WD, Corrigan D. Resting metabolic rate in weight-cycling collegiate wrestlers compared with physically active, noncycling control subjects. *Am J Clin Nutr*. 1990; 52: 409-414.

Phinney SD, Tang AB, Waggoner CR, Tezanos-Pinto RG, Davis PA. The transient hypercholesterolemia of major weight loss. *Am J Clin Nutr*. 1991; 53: 1404-1410.

Shapiro CM, Driver H, Cheshire K, Carver A, Hannan J. Sleep and body composition. *Basic Life Sci*. 1990; 55: 231-235.

Sonnichsen AC, Richter WO, Schwandt P. Reduction of lipoprotein (a) by weight loss. *Int J Obes*. 1990; 14: 487-494.

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

Vansant GA, Van Gaal LF, De Leeuw IH. Decreased diet-induced thermogenesis in gluteal-femoral obesity. *J Am Coll Nutr*. 1989; 8: 597-601.

Vansant GA, Van Gaal LF, Van Acker K, De Leeuw IH. Short- and long-term effects of a very low calorie diet on resting metabolic rate and body composition. *Int J Obes*. 1989; 13(suppl 2): 87-89.

Weits T, van der Beek EJ, Wedel M, Hubben MW, Koppeschaar HP. Fat patterning during weight reduction: a multimode investigation. *Neth J Med*. October 1989; 35: 174-184.

Shoulder

Abrams JS. Special shoulder problems in the throwing athlete: pathology, diagnosis, and nonoperative management. *Clin Sports Med*. 1991; 10: 839-861.

Altchek DW, Warren RF, Skyhar MJ, Ortiz G. T-plasty modification of the Bankart procedure for multidirectional instability of the anterior and inferior types. *J Bone Joint Surg Am*. 1991; 73: 105-112.

Anderson TE, Ciolek J. Specific rehabilitation programs for the throwing athlete. *Instr Course Lect.* 1989; 38: 487-491.

Andrews JR, Kupferman SP, Dillman CJ. Labral tears in throwing and racquet sports. *Clin Sports Med.* 1991; 10: 901-911.

Ciullo JV, Stevens GG. The prevention and treatment of injuries to the shoulder in swimming. *Sports Med.* 1989; 7: 182-204.

Crues JV III, Fareed DO. Magnetic resonance imaging of shoulder impingement. *Top Magn Reson Imaging.* 1991; 3: 39-49.

Ellenbecker TS, Derscheid GL. Rehabilitation of overuse injuries of the shoulder. *Clin Sports Med.* 1989; 8: 583-604.

Gazielly DF. Sports injuries of the shoulder. *Baillieres Clin Rheumatol.* 1989; 3: 627-649.

Gross ML, Seeger LL, Smith JB, Mandelbaum BR, Finerman GA. Magnetic resonance imaging of the glenoid labrum. *Am J Sports Med.* 1990; 18: 229-234.

Gross RM. Arthroscopic shoulder capsulorraphy: does it work? *Am J Sports Med.* 1989; 17: 495-500.

Hawkins RJ, Mohtadi NG. Controversy in anterior shoulder instability. *Clin Orthop.* 1991; 272: 152-161.

Hershman EB, Wilbourn AJ, Bergfeld JA. Acute brachial neuropathy in athletes. *Am J Sports Med.* 1989; 17: 655-659.

Hurley JA, Anderson TE. Shoulder arthroscopy: its role in evaluating shoulder disorders in the athlete. *Am J Sports Med.* 1990;18:480-483.

Janda DH, Loubert P. Basic science and clinical application in the athlete's shoulder. A preventative program focusing on the glenohumeral joint. *Clin Sports Med.* 1991; 10: 955-971.

Jobe FW. Impingement problems in the athlete. *Instr Course Lect.* 1989; 38: 205-209.

Jobe FW, Giangarra CE, Kvitne RS, Glousman RE. Anterior capsulolabral reconstruction of the shoulder in athletes in overhand sports. *Am J Sports Med.* 1991; 19: 428-434.

Jobe FW, Kvitne RS, Giangarra CE. Shoulder pain in the overhand or throwing athlete. The relationship of anterior instability and rotator cuff impingement [published erratum appears in *Orthop Rev* 1989; 18: 1268] *Orthop Rev.* 1989; 18: 963-975.

Mann G. Isolated infraspinatus atrophy. A common cause of posterior shoulder pain and weakness in throwing athletes? *Am J Sports Med.* 1989; 17: 732.

Mellerowicz H, Stelling E, Kefenbaum A. Diagnostic ultrasound in the athlete's locomotor system. *Br J Sports Med.* 1990; 24: 31-39.

Miniaci A, MacDonald PB. Open surgical techniques in the athlete's shoulder. *Clin Sports Med.* 1991; 10: 929-954.

Newberg AH. Computed tomography of joint injuries. *Radiol Clin North Am.* 1990; 28: 445-460.

Nirschl RP. Rotator cuff surgery. *Instr Course Lect.* 1989; 38: 447-462.

Nirschl RP. Rotator cuff tendinitis: basic concepts of pathoetiology. *Instr Course Lect.* 1989; 38: 439-445.

Otis JC, Warren RF, Backus SI, Santner TJ, Mabrey JD. Torque production in the shoulder of the normal young adult male. The interaction of function, dominance, joint angle, and angular velocity. *Am J Sports Med.* 1990; 18: 119-123.

Savoie FH. Evaluation and management of disorders of the shoulder: Part I. Evaluation of the shoulder: examination in throwing athletes. *J Miss State Med Assoc.* 1989; 30: 249-253.

Scarpinato DF, Bramhall JP, Andrews JR. Arthroscopic management of the throwing athlete's shoulder: indications, techniques, and results. *Clin Sports Med.* 1991; 10: 913-927.

Scheib JS. Diagnosis and rehabilitation of the shoulder impingement syndrome in the overhand and throwing athlete. *Rheum Dis Clin North Am.* 1990; 16: 971-988.

Schultz JS, Leonard JA Jr. Long thoracic neuropathy from athletic activity. *Arch Phys Med Rehabil.* 1992; 73: 87-90.

Silliman JF, Hawkins RJ. Current concepts and recent advances in the athlete's shoulder. *Clin Sports Med.* 1991; 10: 693-705.

Uhthoff HK, Sarkar K. Classification and definition of tendinopathies. *Clin Sports Med.* 1991; 10: 707-720.

Wallace WA. Sporting injuries to the shoulder. *J R Coll Surg Edinb.* 1990; 35 (6 Suppl): S21-26.

Warner JJ, Warren RF. Consideration and management of rotator cuff tears in athletes. *Ann Chir Gynaecol.* 1991; 80: 160-167.

Yoneda M, Hirooka A, Saito S, Yamamoto T, Ochi T, Shino K. Arthroscopic stapling for detached superior glenoid labrum. *J Bone Joint Surg Br.* 1991; 73: 746-750.

Steroids

American Academy of Pediatrics Committee on Sports Medicine. Anabolic steroids and the adolescent athlete. *Pediatrics.* 1989; 83: 127-128.

Baldo-Enzi G, Giada F, Zuliani G, et al. Lipid and apoprotein modifications in body builders during and after self-administration of anabolic steroids. *Metabolism.* 1990; 39: 203-208.

Carlson MJ. Are steroids muscling in on your patients? *Ohio Med.* 85: 777-779.

Council on Scientific Affairs. Medical and nonmedical uses of anabolic-androgenic steroids. *JAMA.* 1990; 264: 2923-2927.

Diagle RD. Anabolic steroids. *J Psychoactive Drugs.* 1990; 22: 77-80.

Hickson RC, Ball KL, Falduto MT. Adverse effects of anabolic steroids. *Med Toxicol Adverse Drug Exp.* 1989; 4: 254-271.

Holden SC, Calvo RD, Sterling JC. Anabolic steroids in athletics. *TexMed.* March 1990; 86: 32-36.

Johnson NP. Was superman a junky? The fallacy of anabolic steroids. *JSC Med Assoc.* January 1990; 86: 46-48.

Kleiner SM. Performance-enhancing aids in sport: health consequences and nutritional alternatives. *J Am Coll Nutr.* 1991; 10: 163-176.

Krowchuk DP, Anglin TM, Goodfellow DB, Stancin T, Williams P, Zimet GD. High school athletes and the use of ergogenic aid. *Am J Dis Child.* 1989; 143: 486-489.

Lindstrom M, Nilsson AL, Katzman PL, Janzon L, Dymling JF. Use of anabolic-androgenic steroids among body builders—frequency and attitudes. *J Intern Med.* June 1990; 227: 407-411.

Lombardo JA. Anabolic-androgenic steroids. *NIDA Res Monogr.* 1990; 102: 60-73.

Masse R, Ayotte C, Bi HG, Dugal R. Studies on anabolic steroids. III. Detection and characterization of stanozolol urinary metabolites in humans by gas chromatography-mass spectrometry. *J Chromatogr.* December 1989; 497: 17-37.

Murray RD. Anabolic steroids and the Ohio State Medical Board. *Ohio Med.* 1990; 86: 631-632.

Pugh ML. Steroids: friend or fiend. *WDA J.* 1989; 65: 218,231.

Scarpino V, Arrigo A, Benzi G, Garrattini S, LaVecchia C, Bernardi LR, Silvestrini G, Tuccimei G. Evaluation of prevalence of "doping" among Italian athletes. *Lancet.* October 27, 1990; 336: 1048-1050.

Scott MJ Jr, Scott MJ III. Dermatologists and anabolic-androgenic drug abuse. *Cutis.* July 1989; 44: 30-35.

Tricker R, O'Neill MR, Cook D. The incidence of anabolic steroid use among competitive bodybuilders. *J Drug Educ.* 1989; 19: 313-325.

Urhausen A, Holpes R, Kindermann W. One- and two-dimensional echocardiography in bodybuilders using anabolic steroids. *Eur J Appl Physiol.* 1989; 58: 633-640.

Yesalis CE, Anderson WA, Buckley WE, Wright JE. Incidence of the nonmedical use of anabolic-androgenic steroids. *NIDA Res Monogr.* 1990; 102: 97-112.

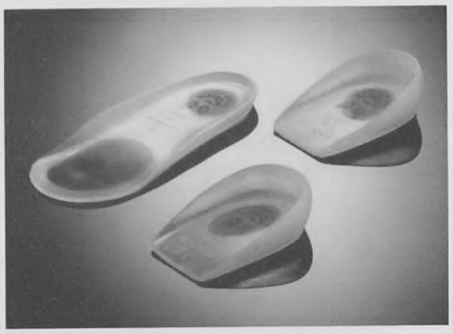
Zlotsky NA. Anabolic steroids and athletes. *Conn Med.* 1989; 53: 241.

Zuliani U, Bernardini B, Catapano A, Campana M, Cerioli G, Spattini M. Effects of anabolic steoids, testosterone and HGH on blood lipids and echocardiographic parameters in body builders. *Int J Sports Med.* February 1989; 10: 62-66.

New Products

Barrie Steele, MS, ATC

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 consistences 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 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 models pictured above are: (1) WonderSport, which has a ¾ 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 Silipos medical grade 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

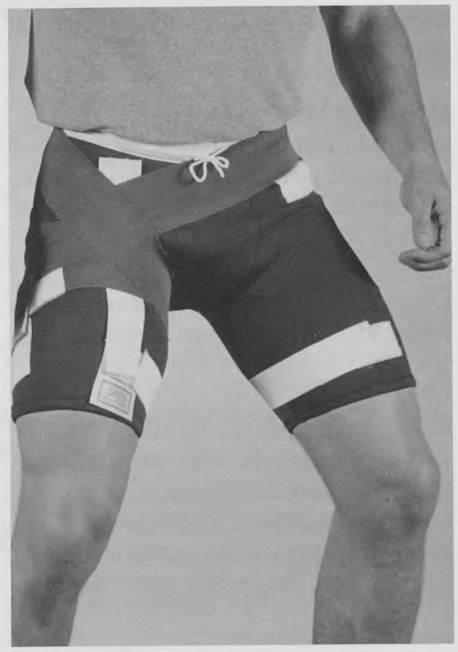
Orthopedic Physical Therapy Products (OPTP) has introduced the new Customized Sticker Exercise Program. This new concept in exercise therapy incorporates the use of peel-off illustrated exercise stickers for customizing patient exercise programs. Patients appreciate the simplicity of the colorful one-page 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.

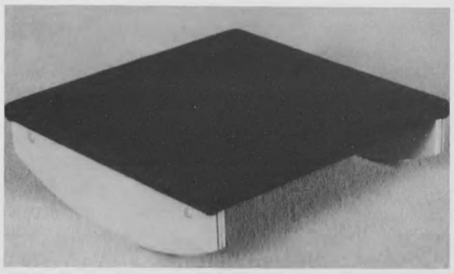
Brace International Bar 1 Pants: A Budget Bashing Way to Eliminate Taping



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.

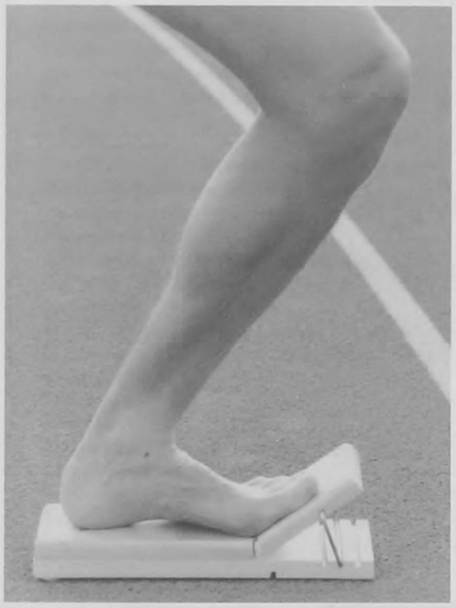
Model 227 Rocker Balance Square Introduced



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

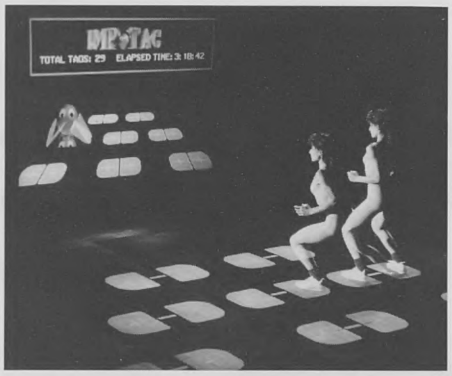


Stretching is a vital part of rehabilitating and preventing injuries to the lower leg and the foot. However, many people do not spend a sufficient amount of time stretching. The FOOTFLEX conveniently fits into any schedule, and can be used effectively for a few minutes while standing at the bathroom vanity preparing for work or while preparing for bed.

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 rehabilitation system based on IMPULSE's newly patented force/time sensor technology. VIDEO TRAQ can precisely measure and develop what were previously the most difficult to quantify aspects of functional performance. Reaction time, force development quickness, movement speed, agility, stability, plyometric/eccentric capability, anaerobic power and endurance are easily quantified during functional, weight-bearing activities without the constraints of equipment or attachments. For the first time, specific functional effects of musculoskeletal and neuromuscular deficits can be directly measured.

In addition to its unique testing capabilities, VIDEO TRAQ provides highly motivational and effective rehabilitative exercise and incomparable sports movement skills training. Virtually any weight-bearing movement—cutting, jumping, dodging, or simply performing multiple weight transfers in varying directions—can be tested or developed. Life-size, real-time, interactive graphics simulate the reaction and movement cues of sports and functional activities.

Unlike any force platform previously available, the IMPULSE platform has a resilient, high-traction surface ideal for human movement. It is sensitive to invisible joint oscillations or maximum force takeoffs and landings. The cost is a fraction of that of older technologies; therefore, the platforms can be used in large-scale, multiple arrays. Strategically positioned platforms are embedded in durable material that can be easily installed in most facilities. A data acquisition module and graphics computer couple this instrumented floor to a unique video/computer display. Proprietary software generates game-like simulations or specific testing and rehabilitation protocols using graphic cues to which the patient responds. As the subject moves between target platforms, time intervals and ground force changes are precisely measured. Performance factors can be compared for any combination of right, left, forward, and backward movements, or for individual right and left leg tests. IMPULSE's powerful PC database provides versatile record storage and reporting capability.

For more information, contact IMPULSE Technology, Inc. at 30612 Salem Drive, Bay Village, OH 44140, or call (216) 835-5410 or (216) 835-9648.

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.

Give Us Your Best Shot . . .

. . . 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.

Winners will be notified by the Publications Office. After a photograph is accepted, the photographer must sign a release statement that gives the NATA permission for a one-time use of the photo. Payment will be made when the *NATA News* goes to press. The photographer will be credited for the photo and will receive extra copies of that edition of the *NATA News*.

So, start snapping and send us your pictures.

There are a few rules:

- Submit a professional-quality color photograph, no smaller than 4" x 6".
- Superior black-and-white prints will be considered.
- Include your name, address, affiliation, and phone number on a separate sheet. Do not write on the back of the photo.
- Provide as much detail as possible about the photo (when taken, name(s) of subject(s), city, state, etc.).
- Send only photos that have not appeared in a publication before.
- Send photos to:

NATA Publications Office
569 Southlake Boulevard
Richmond, Virginia 23236
(800) 800-NATA

Authors' Guide

(Revised February 1992)

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

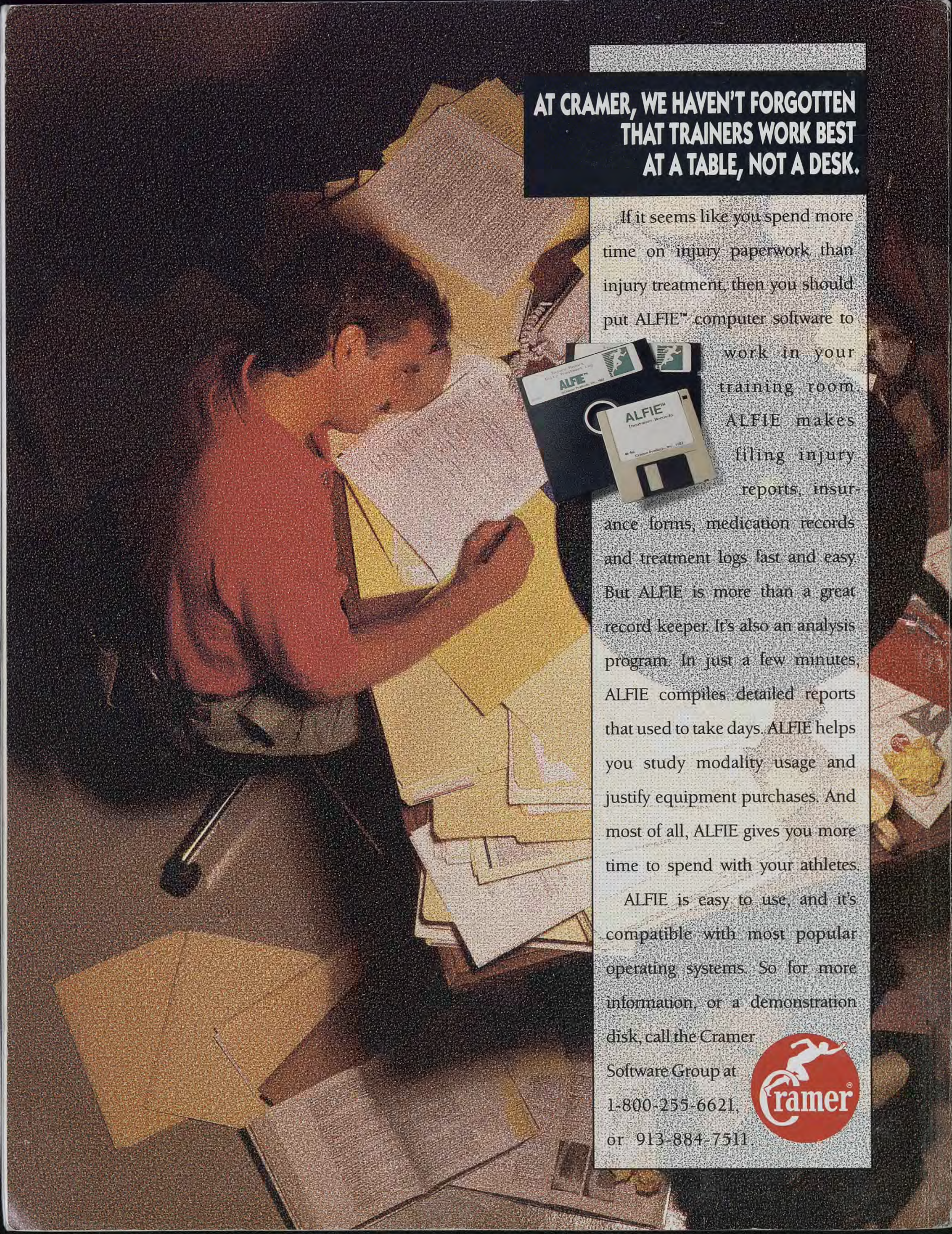
SUBMISSION POLICIES

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. "This manuscript contains original unpublished material that has been submitted solely to the *Journal of Athletic Training*, is not under simultaneous review by any other publication, and will not be submitted elsewhere until a decision has been made concerning its suitability for publication by the *Journal of Athletic Training*. In consideration of the NATA's taking action in reviewing and editing my (our) submission, the author(s) undersigned hereby transfers, assigns, or otherwise conveys all copyright ownership to the NATA, in the event that such work is published by the NATA."
3. 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.
4. The *Journal of Athletic Training* uses a double blind review process. Authors should not be identified in any way except on the title page.
5. 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 editors.
6. 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 ½ x 11 inch plain paper, double spaced, with one-inch margins. **Do not right justify pages.**
9. Manuscripts should contain the following, organized in the order listed below, with each section beginning on a separate page:
   a. Title page
   b. Acknowledgements
   c. Abstract and key words (first numbered page)
   d. Text (body of manuscript)
   e. References
   f. Tables - each on a separate page
   g. Legends to illustrations
   h. Illustrations
10. Begin numbering the pages of your manuscript with the abstract page 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 confuse the abstract with the introduction.
14. List three to six key words or phrases that can be used in a subject index to refer to your paper. These should be on the same page as, and following, your abstract. For **tips from the field**, 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, possibly one sentence. Sections must be arranged so that they progressively focus on the problem or question posed in the introduction.
   c. The body of a **case study** should include the following components: personal data (age, sex, race, marital status, and occupation when relevant - but not name), chief complaint, history of present complaint (including symptoms), results of physical examination (example: "Physical findings relevant to the rehabilitation program were . . ."), medical history (surgery, laboratory results, exam, etc.), diagnosis, treatment, and clinical course (rehabilitation until and after return to competition) criteria for return to competition, and deviation from the expected (what makes this case unique). NOTE: It is mandatory that the *Journal of Athletic Training* receive, with the manuscript, a release form signed by the individual being discussed in the case study. Case studies cannot be reviewed if the release is not included.
   d. The body of a **technique article** should include both the *how* and *why* of the technique; a step-by-step explanation of how to perform the technique, supplemented by photographs or illustrations; and why the technique should be used. The discussion of *why* should review similar techniques, point out how the new technique differs, and explain the advantages and disadvantages of the technique in comparison to the other techniques.
   e. A **tip from the field** is similar to a technique article but much shorter. The tip should be presented and its significance briefly discussed and related to other similar techniques.
17. The manuscript should not have a separate summary section - the abstract serves as a summary. It is appropriate, however, to tie the article together with a summary paragraph or list of conclusions at the end of the discussion section.
18. Citations in the text of the manuscript take the form of a number in parentheses, which indicates the number assigned to the citation. It is placed directly after the reference or the name of the author being cited. References should be used liberally. It is unethical to present others' ideas as your own. Also, use references so that readers who desire further information on the topic can benefit from your scholarship.
19. The Reference page(s) accompanying a manuscript should list authors numerically and in alphabetical order, and should be in the following form: a) articles: author(s) (list all) with the family names then initials, title of article, journal title with abbreviations as per *Index Medicus* (underlined), month (if journal is not consecutively paged throughout the volume), year, volume, inclusive pages; b) books: author(s), title of book (underlined), city and state of publication, publisher, year, inclusive pages of citation. Examples of references to a journal, book, and presentation at a meeting are shown below. See the *AMA Manual of Style* for others.
   a. Knight K. Tips for scientific/medical writers. *Athletic Training, JNATA*. 1990; 25:47-50.
   b. Day RA. *How to Write and Publish a Scientific Paper*. 3rd ed. Phoenix, Ariz: Oryx Press; 1988: 54-55.
   c. Albohm M. Common injuries in women's volleyball. In: Scriber K, Burke EJ, eds. *Relevant Topics in Athletic Training*. Ithaca, NY: Mouvement Publications; 1978: 79-81.
   d. Behnke R. Licensure for athletic trainers: problems and solutions. Presented at the 29th Annual Meeting and Clinical Symposium of the National Athletic Trainers' Association; June 15, 1978; Las Vegas, Nev.
20. Tables must be typed. See references cited in #5 or #19a for table formatting. Type legends to illustrations on a separate page.
21. Photographs should be glossy black and white prints. Do not: use paper clips, write on photos, or attach photos to sheets of paper. Carefully attach a write-on label to the back of each photograph so that the photograph is not damaged.
22. Graphs, charts, or figures should be of good quality and clearly presented on white paper with black ink in a form that will be legible if reduced for publication. All artwork to be reproduced should be submitted as camera-ready black and white line art. If it is to be reproduced in black plus a second (or more) color, submit it as black and white line art. Clearly mark each area of color, shading, or screening (a percent or tint of black or a color), on a separate photocopy. The author will pay all costs for color reproduction.

Advertisers' Index


AT CRAMER, WE HAVEN'T FORGOTTEN THAT TRAINERS WORK BEST AT A TABLE, NOT A DESK.
If it seems like you spend more time on injury paperwork than injury treatment, then you should put ALFIE™ computer software to work in your training room. ALFIE makes filing injury reports, insurance forms, medication records and treatment logs fast and easy. But ALFIE is more than a great record keeper. It's also an analysis program. In just a few minutes, ALFIE compiles detailed reports that used to take days. ALFIE helps you study modality usage and justify equipment purchases. And most of all, ALFIE gives you more time to spend with your athletes.
ALFIE is easy to use, and it's compatible with most popular operating systems. So for more information, or a demonstration disk, call the Cramer Software Group at 1-800-255-6621, or 913-884-7511.
Cramer®