JOURNAL OF ATHLETIC TRAINING

VOLUME 31 • NUMBER 1 • JANUARY–MARCH 1996

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Volume 31, Number 1, January-March

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The *Journal of Athletic Training* (ISSN 1062–6050) 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 the views expressed. Rates available upon request.

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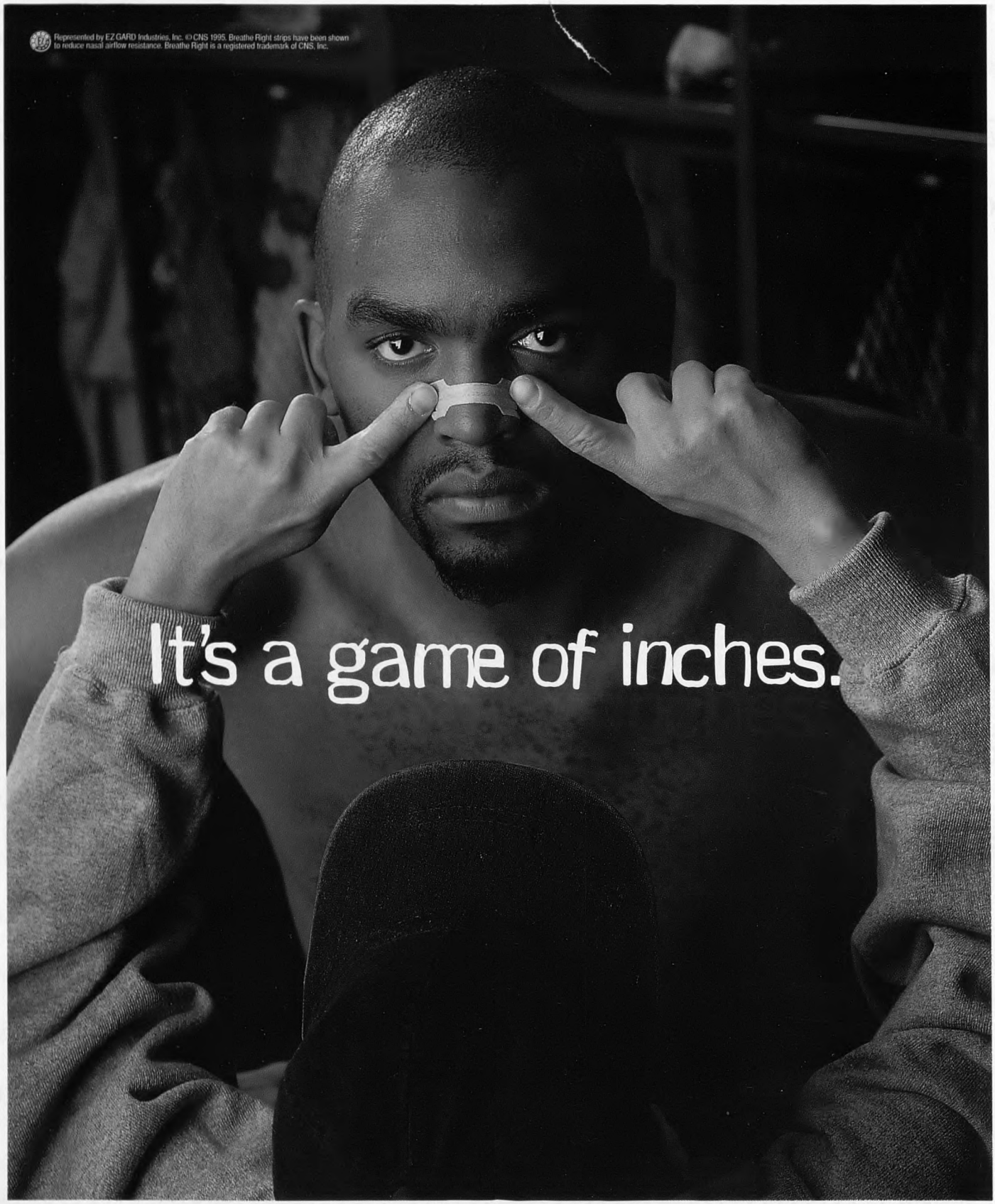

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Letters to the Editor

Comment on "Kinematics and Electromyographic Analysis of Elbow Flexion During Internal Exercise" by Tracy et al.

As a long-standing member of the NATA, I have witnessed the evolution of the layout and content of our journal into the respected and important communication tool that it now represents to the health care fields.

I was especially interested in and pleased to see the inclusion of the article by Tracy et al: "Kinematic and Electromyographic Analysis of Elbow Flexion During Inertial Exercise" in the September issue (*JAT*, 1995;30: 254–258). Both Mr. Tracy and Mr. Obuchi were graduate students of mine at Georgia State University and my interest and clinical experiences with inertial exercise were discussed with them during their program. So, it was with personal investment that I read the article and, in turn, my works were liberally cited in the study.

Consequently, it concerns me that the article abstract states that no research on effectiveness of inertial exercise on improving muscle can be cited. Reference 2 represents a study published specifically to examine the effectiveness of inertial training, also using elbow flexion motions. The conclusions of Reference 2 clearly demonstrate effectiveness of muscle torque training based on statistical sampling and referred approval by the *Index Medicus* journal, *Journal of Orthopaedic and Sports Physical Therapy*, and I have enclosed a copy of this abstract for your review.

While I applaud the authors for their important study on inertial exercise, I request that the issue question of "effectiveness" be clarified or corrected for the readership as you deem appropriate.

Thank you for your kind attention to this matter.

Mark S. Albert, MEd, PT, SCS, ATC
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Atlanta, GA 30324

Author's Response

The abstract of our study "Kinematic and Electromyographic Analysis of Elbow Flexion During Inertial Exercise" published in the September issue inadvertently omitted reference to a current study by Albert et al that was cited in the text. This study showed significant increases in muscular torque due to inertial exercise. The omission was an oversight on our part of important research that supports the use of inertial exercise as a muscular training device.

James E. Tracy, MS, PT, ATC, CSCS
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Cooling Does Not Affect Knee Proprioception

Heather A. Thieme, MA, ATC; Christopher D. Ingersoll, PhD, ATC; Kenneth L. Knight, PhD, ATC; John C. Ozmun, PED

ABSTRACT: The effect of cooling on proprioception of the knee has not been studied extensively. In this study, we investigated the movement reproduction (timing and accuracy) aspect of proprioception. Subjects were tested under two conditions: a 20-minute application of ice and control. Proprioceptive accuracy and timing were measured by passively moving the knee, then comparing the subject's active reproduction of the passive movement. Subjects were blindfolded, then tested in three sectors of the knee's range of motion: 90° to 60°, 60° to 30°, and 30° to full extension. Ice application had no apparent effect on the subject's ability to perform accurate movement reproductions in the sectors tested. However, accuracy of the subject's final angle reproduction varied between the sectors as did the total time of the movement. One possible explanation for the difference between sectors is that different receptors are active at different points in the knee's range of motion. We conclude that cooling the knee joint for 20 minutes does not have an adverse effect on proprioception.

Proprioception is part of sports injury rehabilitation[11,12,16,21,22] because it is central to maintaining posture,[1] balance,[12] joint position sense,[5] and coordination of multi-joint movements.[6,17] Therefore, proprioception is central in performing physical skills correctly and safely.[11,12,15,16,19–22] Decreased proprioceptive ability causes ankle reinjury following an ankle sprain[20,23] and accounts for increased falls in older women.[12]

The stretch receptors of the skeletal muscles and tendons and the mechanoreceptors of the joints are generally considered central to joint position sense in articular proprioception.[14,24] The involvement of specific receptors in proprioception is difficult to determine,[2–4,7,18] probably due to the body's ability to use a wide variety of sensory inputs to determine joint position and movement.[5,6]

The most common modality used for treatment is ice[9,10,13] because it enhances exercise and because of its hypalgesic effect. A potentially negative effect of ice therapy is that the velocity of sensory nerve impulse transmissions decreases gradually as temperature decreases. Decreased afferent fiber conduction velocity may result in altered proprioceptive input. This would predispose the athlete to further injury by reducing the ability of the affected receptors to quickly and efficiently communicate proprioceptive information. Such alterations could affect the use of cryokinetics in rehabilitation regimens. This study was designed to examine the effect of a 20-minute ice application on the proprioceptive ability of the knee, specifically movement reproduction.

Heather A. Thieme was a graduate student at Indiana State University at the time of this study. She is currently an athletic trainer in the Rehabilitation and Sports Injury Department of the Palmer College of Chiropractic at 1000 Brady Street in Davenport, IA 52804.

Christopher D. Ingersoll is an associate professor in the Athletic Training Department at Indiana State University.

Kenneth L. Knight is a professor and chairperson of the Athletic Training Department at Indiana State.

John C. Ozmun is an associate professor of Physical Education at Indiana State.

METHODS

A 2 × 2 × 3 repeated-measures factorial guided this study. Independent variables included treatment (ice and control), order (ice first or second), and three sectors of knee movement (90° to 60°, 60° to 30°, and 30° to full extension). There were four dependent variables measured: 1) differences in the peak angle, 2) differences in the final angle, 3) differences in the time from the start of the movement to the peak angle, and 4) differences in the total time of the movement.

Thirty-seven subjects (16 females and 21 males, 23.4 ± 6.3 years) who had not experienced knee surgery or debilitating knee injuries and who reported no hypersensitivity to cold were recruited. The study was approved by the Indiana State University Institutional Review Board, and subjects gave their informed consent.

Subjects came to two sessions, commencing with either a 20-minute ice application to the left leg or 20 minutes of sitting (control session). The treatment order was randomly assigned. The supine subject's left knee was cooled using two ice packs, one covering approximately 10 cm above to 10 cm below the patella, with the other placed on and around the popliteal space. Each ice pack consisted of a 30.5 × 49-cm plastic bag containing approximately 1160 g of ice. The two bags were arranged to surround the knee completely, so the sides of the knee were cooled as well. The ice pack was applied for 20 minutes before the subject was seated on the Kin-Com Isokinetic Dynamometer (Chattecx Corp, Hixson, TN).

A wrist air splint (37.5 cm long and 14.0 to 18.5 cm wide at each end) was placed over the subject's lower leg to reduce cutaneous information from the pressure of the Kin-Com lever arm. The top edge of the splint was placed just below the patella and the bottom edge above the level of the malleoli, while the leg was placed in full extension. The splint was inflated to a pressure of 1 psi. For nine subjects whose lower leg was too large for the splint, an air splint was placed between the leg and the shin pad of the Kin-Com lever arm. This air splint was partially inflated until the pressure of the

lever arm could not be felt against the leg. Subjects were blindfolded and seated in an upright position.

Subjects' knees were passively moved to one of three randomly assigned starting angles: 90°, 60°, or 30°. The knee was then extended to an arbitrary angle within 30° of the starting angle (the peak angle), and returned to within ±5° of the starting angle (the final angle). Total time of the movement was approximately 1.5 to 2.0 seconds. Subjects were told when the starting angle, the peak angle, and the final angle were reached. They were then asked to reproduce this passive movement as accurately as possible for both the angles and timing of the motion.

The subject actively reproduced one passive movement in each sector, with the sector order randomly assigned. The procedure was repeated for a total of six movement reproductions for each treatment condition. The order of the sectors was randomly assigned to each subject, but the order remained the same for both days of testing. Pilot study data on eight subjects supported the use of two trials in each sector during the final study.

Angles and time were extracted from Kinetic Communicator Dynamometer (Kin-Com) assessment files using customized software that subtracted the passive measurements from the active measurements. The most accurate trial (as determined by the most accurate reproduction of the peak angle) of the two trials in each sector and condition was used for statistical analysis. If the peak angle difference was the same, the first trial was used. The best angle was used rather than averaging the two trials to eliminate the possibility of one underestimated and one overestimated angle canceling each other in the results, thereby falsely appearing as a near accurate reproduction.

The results were then analyzed using a MANOVA with repeated measures to determine if differences existed between control and cold application sessions, the three sectors of movement, and the order in which the subject was tested for the four dependent measures. Univariate F-tests and the Newman-Keuls test ($p \leq .05$) were used to determine the locations of differences.

RESULTS

There was no difference in proprioceptive ability between ice treatment and control sessions ($F(1,213) = 1.09$, $p = .30$; Tables 1 through 4) or ordinal positions ($F(2,213) = .92$, $p = .40$).

Table 1. Movement Reproductions for Peak Angle (Differences Are Between Passive and Active in Degrees; Mean ± SD)

		Sectors		
Treatment	All Sectors	90° to 120°	120° to 150°	150° to Full Extension
Ice	1.5 ± 7.3	2.2 ± 9.2	1.1 ± 6.4	1.2 ± 5.9
Control	2.1 ± 7.5	2.3 ± 7.3	2.7 ± 6.9	1.4 ± 7.8

Note: Positive numbers indicate the knee was in greater extension during active reproduction than the passive angle.

Table 2. Movement Reproductions for Final Angle (Differences Are Between Passive and Active in Degrees; Mean ± SD)

		Sectors		
Treatment	All Sectors	90° to 120°	120° to 150°	150° to Full Extension
Ice	−0.8 ± 11.5	3.3 ± 9.6†‡	−4.2 ± 13.2*	−1.4 ± 10.5*
Control	−2.8 ± 12.2	1.1 ± 9.4†‡	−5.2 ± 10.1*	−4.3 ± 15.5*

Note: Negative numbers indicate the knee was in greater flexion during active reproduction than the passive angle.
* Different from sector A at $p < .05$.
† Different from sector B at $p < .05$.
‡ Different from sector C at $p < .01$.

Table 3. Movement Reproductions for Time to Peak Angle (Differences Are Between Passive and Active in Seconds; Mean ± SD)

		Sectors		
Treatment	All Sectors	90° to 120°	120° to 150°	150° to Full Extension
Ice	.15 ± .46	.25 ± .51	.14 ± .46	.05 ± .40
Control	.14 ± .39	.23 ± .46	.05 ± .31	.14 ± .38

Note: Positive numbers indicate the active movement reproduction took more time than the passive movement.

Table 4. Movement Reproductions for Total Time of Repetition (Differences Are Between Passive and Active in Seconds; Mean ± SD)

		Sectors		
Treatment	All Sectors	90° to 60°	60° to 30°	30° to 0°
Ice	−.23 ± .70	−.05 ± .86	−.28 ± .64	−.35 ± .54
Control	−.27 ± .70	−.07 ± .92	−.28 ± .57	−.48 ± .49

Note: 90° to 60° sector is different from 30° to 0° sector ($p < .05$) for both treatments.

There was a difference in final angle reproduction and total time of the movement between sectors ($F(2,213) = 6.53$, $p = .002$) for both the ice and control sessions. For final angle reproduction, subjects underestimated the 90° to 60° sector's final angle and overestimated the final angle in the sectors toward greater extension (60° to 30° and 30° to 0°) (Table 2; $F(2,72) = 9.35$, $p < .0005$).

For total time of repetition, total time was longer in the 30° to 0° sector than the 90° to 60° sector for both treatment sessions ($F(2,72) = 8.42$, $p = .001$; Table 4). Peak angle and time to peak angle were not different (Tables 1 and 3).

Subjects' performances were different between testing days ($F(1,213) = 16.49$, $p < .0005$). On the first day, subject's active reproduction of the final angle was 3.9° more toward flexion than passive movement and 4° more toward extension actively than passively on the second day ($F(1,36) = 9.71$, $p = .004$). The effect of day was not significant for peak angle ($p = .52$) and time to peak ($p = .56$). For total time of repetition, subjects were .344 seconds slower than the passive motion on day 1 and were .148 faster on day 2 ($F(1,36) = 6.93$, $p = .012$).

Only 6.8% (R^2 = .068) of the variance in the final angle differences and 4.6% of the variance (R^2 = .046) in the total time differences were explained by the variables.

DISCUSSION

A 20-minute ice treatment had no effect on joint angle reproduction. This agrees with others who found no significant effect of ice treatments on ankle[10] or hand[25] proprioception. Although subjects often walked awkwardly and slowly to the Kin-Com machine after the ice application, the ice did not negatively affect the ability to judge the placement of the joint when moved passively, nor did the ice affect subjects' ability to actively repeat the passive movement. The trend in the data suggested that cooling actually improved proprioceptive ability, particularly in the 30° to full extension sector of the range of motion.

There are three possible explanations for the differences in proprioceptive ability between the sectors of movement. One possibility is the type of receptors stimulated at different points in the range of motion. Joint receptors are more active when the joint is approaching full extension,[8] while the muscles play a greater role in the mid range of motion.[8,14,24] If the change in movement reproduction is due to increased recruitment of joint afferents, a difference should have been observed between 60° to 30° and 30° to full extension in the range of motion. However, these two sectors had almost identical data.

The second explanation is a difference within the muscle receptors. The muscles contain more than one type of afferent receptors, which are sensitive to different types of stretching. However, it seems unlikely that these different receptors caused the change in final angle reproduction. The Golgi tendon organ does not emit charges during rest in the mid range of motion, nor is it very sensitive to passive stretching,[24] so it would seem to play a very small part in the movement reproduction of this study. Primary spindle endings have a high sensitivity to passive muscle stretch, which increases with the speed of the movement, but show no sensitivity to passive shortening. Secondary muscle spindle endings have a similar sensitivity to the primary endings, but at a lower level of discharge.[24] The primary and secondary muscle endings are therefore the dominant muscle receptors of this study, but, according to the literature, play very similar roles and would not be distinguishable in movement reproduction.[8,14,24]

The third and most likely explanation for the differences between sectors may be the methods used in our study. The sectors 60° to 30° and 30° to full extension may have been more affected by gravity than the sector 90° to 60°. Perhaps the subjects could not control their flexion to the final angle as accurately in the two sectors of extension because of the greater pull of gravity on the Kin-Com arm and their legs. This would lead to the final angle being in greater flexion than the passive movement. This argument is strengthened by the differences in total time of the repetition. Subjects were faster in the performance of their repetitions in sectors 60° to 30° and 30° to full extension, which also suggests less controlled flexion movement than that in the 90° to 60° sector. To eliminate the effects of gravity on the knee joint, subjects could be tested sidelying or in an upright position.

Almost none of the variability in the measures was the result of cooling—less than 7% as evidenced by the R^2 values. Apparently, the nerve was not cooled enough during the 20-minute application of two ice packs to alter proprioceptive transmission. We tested proprioception with the knee isolated (ie, in open kinetic chain). During closed chain activities, which are used during functional rehabilitation such as cryokinetics, many more joints and receptors are involved in proprioception. Thus the minimal effects we observed during open chain testing would be even less pronounced during functional activities. Therefore, cooling can be safely used to facilitate exercise during rehabilitation without fear of reinjury due to decreased proprioception.

REFERENCES

1. Ashton-Miller JA, McGlashen KM, Schultz AB. Trunk positioning accuracy in children 7–18 years old. *J Orthop Res*. 1992;10:217–225.
2. Barrack RL, Skinner HB, Brunet ME, Haddad RJ. Functional performance of the knee after intraarticular anesthesia. *Am J Sports Med*. 1983;11:258–261.
3. Barrack RL, Skinner HB, Cook SD. Effect of articular disease and total knee arthroplasty on knee joint-position sense. *J Neurophysiol*. 1983;50:684–687.
4. Barrett DS, Cobb AG, Bentley G. Joint proprioception in normal, osteoarthritic and replaced knees. *J Bone Joint Surg [Br]*. 1991;73B:53–56.
5. Bevan L, Cordo P, Carlton L, Carlton M. Proprioceptive coordination of movement sequences: discrimination of joint angle versus angular distance. *J Neurophysiol*. 1994;71:1862–1872.
6. Cordo P, Carlton L, Bevan L, Carlton M, Kerr GK. Proprioceptive coordination of movement sequences: role of velocity and position information. *J Neurophysiol*. 1994;71:1848–1861.
7. Dvir Z, Koren E, Halperin N. Knee joint position sense following reconstruction of the anterior cruciate ligament. *J Orthop Sports Phys Ther*. 1988;10:117–120.
8. Grigg P. Mechanical factors influencing response of joint afferent neurons from cat knee. *J Neurophysiol*. 1975;38:1473–1484.
9. Hartviksen K. Ice therapy in spasticity. *Acta Neurol Scand*. 1962;38(suppl 3):79–84.
10. LaRiviere JA. *Effect of Ice Immersion on Joint Position Sense*. Eugene, OR: University of Oregon; 1990:25–29, 32–46. Thesis.
11. Lebert L, Zolik J. Proprioception—the missing link in rehabilitation. *Sideline View*. 1990;11:1–3.
12. Lord SR, Caplan GA, Ward JA. Balance, reaction time, and muscle strength in exercising and nonexercising older women: a pilot study. *Arch Phys Med Rehab*. 1993;74:837–839.
13. Lowden BJ, Moore RJ. Determinants and nature of intramuscular temperature changes during cold therapy. *Am J Phys Med*. 1975;54:223–233.
14. Lynn B. Somatosensory receptors and their CNS connections. *Ann Rev Physiol*. 1975;37:105–125.
15. Paintal AS. Block of conduction in mammalian myelinated nerve fibers by low temperatures. *J Physiol*. 1965;180:1–19.
16. Parkhurst TM, Burnett CN. Injury and proprioception in the lower back. *J Orthop Sports Phys Ther*. 1994;19:282–295.
17. Sainburg RL, Poizner H, Ghez C. Loss of proprioception produces deficits in interjoint coordination. *J Neurophysiol*. 1993;70:2136–2147.
18. Skinner HB, Wyatt MP, Hodgdon JA, Conard DW, Barrack RL. Effect of fatigue on joint position sense of the knee. *J Orthop Res*. 1986;4:112–118.
19. Smyth MM, Marriott AM. Vision and proprioception in simple catching. *J Motor Behav*. 1982;14:143–152.
20. Tomaszewski D. "T-Band Kicks" ankle proprioception program. *Athl Train, JNATA*. 1991;26:216–219.

21. Stone JA, Leuken JS, Timm KE, Ryan EJ. Closed kinetic chain rehabilitation for the glenohumeral joint. *J Athl Train.* 1993;28:34–36.
22. Stone JA, Partin NB, Lueken JS, Timm KE, Ryan EJ. Upper extremity proprioceptive training. *J Athl Train.* 1994;29:15–18.
23. Tropp H, Ekstrand J, Gillquist J. Stabilometry in functional instability of the ankle and its value in predicting injury. *Med Sci Sports Exerc.* 1984;16:64–66.
24. Vallbo AB, Hagbarth KE, Torebjork HE, Wallin BG. Somatosensory, proprioceptive, and sympathetic activity in human peripheral neres. *Physiol Rev.* 1979;59:919–957.
25. Williams ID, Rainham C. Control of finger movements as shown by reducing muscle spindle and joint information. In: Klavora P, Flowers J, eds. *Motor Learning and Biomechanical Factors in Sport.* Toronto, Canada: Pub Division, School of Physical and Health Education; 1980:165–189.

Wound Care Management: Proper Protocol Differs From Athletic Trainers' Perceptions

Michael S. Goldenberg, MS, ATC

ABSTRACT: As research techniques in wound care management improve, treatment protocols for the care of wounds must also change to ensure safe and optimal healing. In this study, I surveyed current practices of athletic trainers regarding the care of athletic wounds and compared the findings to current literature. I contacted 501 athletic trainers, including all NATA curricular undergraduate directors. Overall response rate was 58%; 78% of the athletic trainers from the curricular schools responded. Wet-to-dry, irrigation, and soaks were the three most common methods used to debride and cleanse a wound. Povidone-iodine (Betadine) and hydrogen peroxide were the two most popular cleansing agents. Conventional gauze was the primary dressing used by 67% of the athletic trainers, while 20% of those surveyed used occlusive dressings. Although povidone-iodine and hydrogen peroxide are commonly used, both are toxic to cells involved in the wound-healing process and delay healing. Research indicates that the best method of cleansing and debriding a wound is to irrigate it with saline. Occlusive dressings have a lower infection rate, are viral barriers, and are associated with faster wound healing and less pain than gauze dressings. Athletic trainers need to assess their wound care protocols so that they give the best possible care to their athletes.

Athletic trainers handle a variety of acute and chronic wounds in their daily routines. These wounds range from superficial abrasions to full-thickness lesions. Advances in research technology have increased the understanding of the wound-healing process, leading some health-care providers to believe there is a wound care revolution in the making.[9] Methods taught to athletic trainers and other health care professionals 10 years ago may be questioned today about their suitability to maximize wound healing.

Following inspection of the wound, the procedures followed for the cleansing/debridement of foreign material and the type of dressing applied may affect the rate and/or the effectiveness of the healing process. Certain wound care dressings enhance, while others retard, the proliferation of new tissue.[6,10,14–16,25–27,39] In addition, some methods and cleansing antiseptics are destructive to cells required for the wound healing process.[4,11,12,23,24,29,30,34,35,38] Although some factors cannot be controlled, such as the size and location of the lesion, the athletic trainer's choice of treatment can positively or negatively affect the healing process. Therefore, the purpose of this study was to collect information regarding the methods used by athletic trainers in caring for acute wounds and to compare these findings to current literature.

METHODS

In August 1994, survey packets were distributed to 501 certified athletic trainers across the country. Forty-two athletic trainers from each of the 10 NATA districts were randomly selected from the 1994 NATA Directory. The remaining 81 survey packets were mailed to the directors of undergraduate athletic training curriculum schools listed by the NATA.

Each survey packet included a two-page questionnaire, a cover letter explaining the purpose of the survey, instructions for completing the survey tool, and a self-addressed/stamped envelope. To be included in the study, the questionnaire had to be returned by October 1, 1994. Surveys were color-coded to distinguish the responses of the randomly selected athletic trainers from those of the curriculum directors. Before distribution, several athletic trainers, physicians, and research personnel reviewed the survey tool for content validity.

The two-page questionnaire was designed to gather information about the background of the individual who was completing the survey, how he/she cared for acute wounds, and his/her knowledge of wound care. Most questions were designed for only one response. Questions answered with more than one response were categorized both together as an individual response and then tallied as two separate responses to evaluate the total number of responses for that question.

RESULTS

Of the 501 packets distributed, 280 questionnaires (58%) were returned. Forty were discarded because of incompleteness, unexplained response inconsistencies, or the respondent's departure from the athletic training profession.

The average number of years of experience of the athletic trainers who returned the surveys was 10.4 years. One hundred seven (45%) were employed by a college/university; 49 (20%) by a high school; 29 (12%) by a clinic/high school; 27 (11%) by a clinic only; 9 (4%) represented both the professional level as well as the unemployed; 7 (3%) were students; 2 (.83%) were employed in the college/clinical setting; and 1 (.4%) worked at the intermediate school level.

One hundred forty-one (59%) had received a master's degree, 66 (27%) a bachelor's, and 33 (14%) a doctorate. All districts were represented in the responses, with Districts 1, 2, and 5 having the highest response rates. Of the 81 NATA curricular schools, 63 (78%) responded to this survey.

Most athletic trainers (104 (43%)) used the wet-to-dry method as the primary means of debriding a wound, followed

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by irrigation (91 (38%)) and soaks (26 (11%)). Seventeen (7%) used a combination of the three methods on acute wounds. One hundred respondents (42%) used povidone-iodine (Betadine), while 62 (26%) used hydrogen peroxide as the primary cleansing agent, and 37 (15%) used a combination of the cleansing agents listed on the questionnaire, depending on the type of wound (Table 1).

Different types of dressing can be applied to a wound to aid the healing process. Of the athletic trainers surveyed, 160 (67%) used gauze/adhesive strips, 47 (20%) used occlusive dressings, and 13 (5%) used Second Skin (Spenco Medical Products, Waco, TX). Twenty (8%) used a combination of the three dressings. Fifty-four (34%) of those individuals who used gauze/adhesive strips also used occlusive dressings as a secondary method of care. Of the total number of responses, 66 (78%) of the high school athletic trainers used gauze/adhesive strips, while 71 (60%) of college-level athletic trainers used this conventional method.

The most commonly used (63(41%)) occlusive dressing was DuoDERM (ConvaTec Inc, Princeton, NJ), followed by Bioclusive (Johnson & Johnson Medical Inc, Arlington, TX) (53 (35%)), and Tegaderm (3M Medical-Surgical Division, St Paul, MN) (16 (11%)). Athletic trainers who did not use occlusive dressings did not use them because of the perceived cost (57 (45%)) or a lack of formal education in the area of moist wound healing (37 (29%)).

Athletic trainers surveyed felt the most effective cleansing agent was povidone-iodine (114 (48%)) or hydrogen peroxide (49 (20%)) followed by a combination of different agents (23 (10%)). A majority of respondents felt wounds healed faster in a moist environment (154 (64%)) compared to a dry one (82 (34%)). However, 99 (41%) felt that moist dressings had a higher infection rate compared to the dry dressings (57 (24%)). Eighty-one (34%) felt the infection rate was the same between the two.

DISCUSSION

Wounds must be as clean as possible, but no attempt should be made to sterilize them.[4] The goal is to clean the wound without damaging cells that survived the original trauma or cells that are important in the wound-healing process. Cleansing agents or antiseptics once considered safe are now known to be toxic to fibroblasts and other cells in the wound that enhance healing.[4,11,12,23,24,29,30,34,35,38] There are no criteria for manufacturers to follow regarding the safety and efficacy of their product. Currently, the Food and Drug Administration does not require manufacturers to provide safety results concerning their wound cleansing products before distribution to the public.[11] It is up to the manufacturer to decide product safety. Two products, povidone-iodine and hydrogen peroxide, the agents most commonly used by athletic trainers, have been shown to delay the wound-healing process.

Table 1. Preferred Cleansing Agents

Cleansing Agent Used	No.	%
Povidone-iodine	100	42
Hydrogen peroxide	62	26
Soaps/detergents	19	7
Hibiclens	9	4
Saline	7	3
Water	5	2
Alcohol	1	0
Combination of agents	37	15

Povidone-iodine is an iodophor of iodine and was created due to iodine's low solubility in water and irritations to the skin and mucosal membranes.[30] A 10% povidone-iodine solution consists of 90% water, 8.5% polyvinylpyrrolidone, 1% available iodine, and iodide.[38] This solution was assumed to be superior because it was believed to have all the germicidal properties of iodine, without the toxicity. However, current literature shows this to be false.[4,11,12,23,24,29,30,34,35,38]

Lineaweaver et al[24] compared four different types of antiseptics and found that, at full strength, povidone-iodine, hydrogen peroxide, acetic acid, and sodium hypochlorite were 100% toxic to fibroblasts. They also discovered that, after irrigating wounds in adult rats with povidone-iodine, wound epithelialization was significantly retarded 4 to 8 days later. Tensile strength of the wounds also was significantly weaker than those wounds irrigated with saline or not irrigated at all. In a separate study, Rodeheaver et al[30] demonstrated that povidone-iodine solution had no effect on the rate of infection of a wound compared to a saline control group. Another form of povidone-iodine is povidone-iodine surgical scrub solution, which is povidone-iodine mixed with a detergent. Rodeheaver et al[30] reported that wounds cleansed with this solution had a higher rate of infection than those cleansed with aqueous iodine and povidone-iodine. Povidone-iodine surgical scrub solution was also ineffective in reducing levels of bacteria in a contaminated wound.

Foresman et al[11] tested 16 different cleansing agents in vitro and found that the Betadine surgical scrub solution had to be diluted 1:10,000 before leukocytes were able to perform their phagocytic function. Becker[5] took 35 contaminated head and neck surgical cases and, before closure, irrigated the incision with either saline or povidone-iodine. None of the wounds flushed with saline became infected; however, 28% of the wounds treated with povidone-iodine became infected after closure. Tests done in normal vacutainer tubes with a 1:1 mixture of blood samples and povidone-iodine demonstrated a destruction of both red and white blood cells. The same tests performed with saline had a normal white blood cell count.[29]

In 1993, LeVeen et al[23] cited many cases of toxicity with the use of povidone-iodine and evidence that povidone-iodine is ineffective in preventing infections. There are cases of povidone-iodine absorption on intact skin leading to thyroid dysfunction in children.[23]

Hydrogen peroxide was the second most popular wound cleanser used by athletic trainers. When applied to the wound, it interacts with the enzyme catalase, which is found in tissue and blood, to release oxygen bubbles.[3,33] This effect is advantageous, because it helps kill bacteria and can be used to cleanse infected areas. Hydrogen peroxide has considerable drawbacks, however, when it is used to cleanse and disinfect a wound. Tatnall[34] demonstrated that an increased exposure of human keratinocytes to hydrogen peroxide was toxic to these

cells. Gruber[12] found with human donor sites that hydrogen peroxide applied to a wound caused early separation of the scab. Hydrogen peroxide used after this separation created bullaes, which were caused by the hydrogen peroxide lifting the new epithelium off the dermis. Cases of near-fatal systemic oxygen embolisms and complications due to the irrigation of wounds with hydrogen peroxide under pressure using a syringe have been reported.[3,31] In their clinical practice guideline publication on Pressure Ulcer Treatments,[35] the US Department of Health and Human Services does not recommend the use of hydrogen peroxide when cleaning an ulcer wound because of its toxicity to cells in the wound bed.

Besides the type of antiseptic used, there are different methods of debriding and cleansing a wound of foreign material such as dirt, gravel, and necrotic tissue. Mechanical debridement methods include wet-to-dry gauze, laser debridement, irrigation, and hydrotherapy. Chemical debridement involves the use of topical agents or enzymes. Autolytic debridement uses occlusive dressing which allow the body's own defense mechanisms to debride the wound. Methods most commonly used by athletic trainers in this study were wet-to-dry, irrigation, and soaks.

According to Rodeheaver[29] and the US Department of Health and Human Services,[35] the most effective way to debride and cleanse a wound is to irrigate it with water, saline, or a nontoxic agent. This technique must be performed gently to avoid disrupting the healing tissue. The pressure of the irrigation is more important than the solution used.[19] Pressures recommended by the US Department of Health and Human Services are between 4 and 15 lb/in^2. A saline squeeze bottle (250 mL) with irrigation cap will exert 4.5 lb/in^2 of pressure.[35] Pressures greater than 15 lb/in^2 of force will have damaging effects to the wound tissue. The most popular method used by the respondents, the wet-to-dry method, can be very irritating, painful, and disruptive to healthy tissue.[4] This method entails placing a wet gauze on the wound and leaving it there to dry. The dry gauze is removed along with the attached debris. Soaks, such as those in Dakin's solution can also irritate and damage tissue.

Table 2. Film Dressings*

Acuderm (Acme United, Fairfield, CT)	OpSite† (Smith & Nephew, Largo, FL)
Bioclusive† (Johnson & Johnson Medical Inc, Arlington, TX)	Polyskin (Kendall, Mansfield, MA)
Blister Film (Sherwood Medical, St Louis, MO)	Spandra (Thermedics Inc, Woburn, MA)
Clear-skin (Heritage Surg Corp, Nashiville, TN)	Tegaderm† (3M Medical-Surgical Div, St Paul, MN)
Ensure (Becton Dickinson, Deseret Div, Sandy, UT)	Uniflex (Bioplasty, Inc, St Paul, MN)
Opreflex (Professional Medical, Greenwood, SC)	Viasorb (Sherwood Medical, St Louis, MO)

* From Mertz.[26]
† Commonly used in athletics

After inspecting and cleansing the wound, the type of dressing used can affect the healing process. The conventional method uses a gauze dressing or an adhesive strip with or without a topical ointment, followed by letting the wound "air out" to form a scab. The second method keeps the wound moist with an occlusive dressing that does not allow the formation of a scab.

There are a variety of occlusive or moisture-retentive dressings from which an athletic trainer can choose. Occlusive dressings used in athletics can be placed into three main categories. Film dressings are generally made of a polyurethane film and are transparent (Table 2). This theoretically allows for observation of the wound, but observation is usually obscured by exudate from the lesion.[26] Change of these dressings is recommended when there is a build-up of exudate because film dressings do not have absorbent qualities. This may cause the edges to separate from the skin, allowing leakage and compromising the viral barrier.[26] These films are also waterproof, allowing the athlete to bathe without contaminating the wound. Care must be taken when removing film dressings, because they adhere well to the skin and could damage new wound surface epithelium.[20]

Hydrogel dressings are made of a polyethylene oxide or polyvinylpyrrolidone substance (Table 3).[26] Water comprises about 90% of a dressing's content.[26] This allows for a cooling effect that decreases pain and reduces inflammation.[7,37] As long as it is moist, a hydrogel dressing will not damage new wound surface epithelium when removed. These dressings must be changed daily, increasing the amount of follow-up care the athletic trainer must give to the athlete.

A hydrocolloid dressing is usually composed of two layers, the outer layer made of a polyurethane foam and the inner layer made of hydrophilic particles such as pectin and gelatin (Table 4).[25,26] The hydrocolloids, unlike the film dressings, absorb the exudate from the wound, forming a soft moist mass that creates an optimal environment for healing. The hydrocolloids are waterproof and can be left on the wound for up to 7 days. When a hydrocolloid is removed, it will not damage the new wound surface epithelium.

Although many occlusive dressings are available, 160 (67%) of the athletic trainers surveyed still use gauze as the primary means of covering and protecting a wound. Concerns with this conventional method and its efficiency in wound healing start with the infection rate. Most athletic trainers in this study believed that a moist environment had a greater infection rate than a dry one. However, research has shown that wounds treated with the conventional method have a 7% infection rate versus a 2% infection rate when hydrocolloid dressings are used.[18] The lower infection rate of the moist occlusive dressing may be due to the acidic environment that develops beneath it.[10] This type of environment has been shown to inhibit the growth of two common bacterial strains: *Staphylococcus aureus* and *Pseudomonas aeruginosa*. The lower infection rate may also be due to the great number of leukocytes found under hydrocolloid dressings.[10,18,22] Their presence may keep the

Table 3. Hydrogel Dressings*

Cutinova (Beiersdorf, Norwalk, CT)	Geliperm Wet (Atlanta Inc, Melville, NY)
Elasto Gel (Southwest Technologies, Kansas City, MO)	Spenco 2nd Skin† (Spenco Medical Corp, Waco, TX)
Vigilon Primary Wound Dressing (Bard, North Reading, MA)	

* From Mertz.[26]
† Commonly used in athletics.

Table 4. Hydrocolloid Dressings*

Comfeel (Coloplast Corp, Tampa, FL)	Restore (Hollister Inc, Libertyville, IL)
DuoDERM† (ConvaTec Inc, Princeton, NJ)	Sween-a-peel (Sween Corp, North Mankato, MN)
HydraPad (Baxter, Glendale, Ca)	Tegasorb† (3M Medical-Surgical Div, St Paul, MN)
Intact (Bard, North Reading, MA)	Ulcer Dressing (Johnson & Johnson Medical Inc, Arlington, TX)
IntraSite (Smith & Nephew, Largo, FL)	Ultec (Sherwood Medical, St Louis, MO)

* From Mertz.[26]
† Commonly used in athletics

number of organisms low enough so there is only a colonization of organisms, not enough to cause an infection.

A second concern with the conventional method is the transfer of blood through a gauze dressing. The increased concern about blood-borne pathogens such as hepatitis B and human immunodeficiency virus has heightened the awareness of protection from open wounds. The chances of transmission or infection through athletic competition is minimal; however, the possibility is present.[2] Some occlusive dressings such as DuoDERM and Bioclusive decrease the chances of contraction because they are proven viral barriers.

The rate of healing with gauze or adhesive strips is a third concern about the conventional method. Wounds treated with hydrocolloids heal faster than wounds treated with the conventional method.[1,8,10,14,15,25] Nemeth et al[27] found that occlusive dressing therapy on skin biopsy sites healed wounds three times faster than those treated with the conventional method. Occlusive dressing helps heal wounds faster for various reasons. The area under an occlusive dressing is moist and hypoxic. The lack of oxygen stimulates capillary proliferation from the wound edge to the center. It is believed that macrophages are stimulated by the local hypoxic conditions, and release growth factors that increase the rate of angiogenesis.[10,21] The hypoxic area also stimulates fibroblast function, which helps increase the healing rate.[17,21,36]

Cells require a moist environment in order to migrate across the wound bed for re-epithelialization of new tissue. In the conventional method, a scab retards healing because epidermal cells have to penetrate deeper into the dermis where the environment is moist, which forces the wound to heal only from the bottom up. The moist environment under an occlusive dressing will not allow the formation of a scab, so the wound heals from the sides and bottom.

An important difference between the conventional method and occlusive dressings is the perceived pain from the wound. Occlusive dressings protect nerve endings from the environment and keep them moist, helping to reduce pain. With gauze dressings, nerves may be damaged during changes; however, hydrocolloid dressings do not need to be changed daily and do not damage the underlying new surface when removed. Nemeth et al[27] and others[13–15,25] have demonstrated that subjects treated with hydrocolloid dressings had less pain than those treated with gauze and/or topical ointment creams. Subjects in these studies ranged from football players and other athletes to industrial workers.

Final disadvantages of using gauze dressings or adhesive strips are the follow-up care and cost-effectiveness. Due to the many different types of conditions that affect a dressing during athletic competition, gauze or adhesive strips need to be changed after each athletic event. This increases the time an athletic trainer must spend with the athlete in the training room before and after competition. Some occlusive dressings are made to stay on a wound for up to 7 days, reducing follow-up care. This decreases the time an athlete must spend in the training room for treatment.

Besides being time-efficient, occlusive dressings are more cost-effective in the hospital/home care settings. Shannon[32] compared the cost of two treatment protocols on patients with spinal cord injuries. The number of hydrocolloid dressings used and their total cost were much less than the conventional wet-dry gauze protocol. Hermans[14] feels that the reduced number of dressings used to heal a wound with hydrocolloids in a postoperative setting might help reduce overall treatment costs. Currently, no cost studies have been performed in the athletic training setting. Research is needed to determine cost efficiency.

Even though interscholastic budgets generally are smaller than collegiate budgets,[28] both college and high school athletic trainers explained that the perceived cost (high school = 51%, college = 52%) was the number one reason why they did not use occlusive dressings. Other reasons given were lack of formal education on moist wound healing (high school = 27%, college = 22%) and unfamiliarity with using dressings that retain moisture (high school = 11%, college = 11%). Although basic educational requirements are the same, only 11 (14%) of the high school level athletic trainers who responded, compared to 26 (24%) of the college athletic trainers, use occlusive dressings in their respective settings. This difference could be due to high school budgetary constraints. Overall, only 20% of those athletic trainers surveyed used occlusive dressings as the primary way to heal a wound.

Of the curriculum directors who responded, 33 (52%) used the conventional method, while 17 (27%) used occlusive dressings, and 5 (8%) used Second Skin as the primary way to dress a wound, leaving 8 directors (12%) who used a combination of the three dressings. Eighteen (54%) of those curric-

ular directors who used the conventional method of wound care also used occlusive dressings for specific wounds. Fifteen of the 63 curricular director respondents did not use any form of occlusive dressings when managing wounds. Assuming that athletic trainers teach their students the same clinical techniques they use, 24% of the student athletic trainers entering the work force will not be exposed to the use of occlusive dressings.

One of the principal goals of athletic training is to provide athletes with the best possible care. To ignore those techniques that are proven to be sound through research would be a disservice to athletes.

ACKNOWLEDGMENTS

This research was funded by the Athletic Department at The Lawrenceville School, Lawrenceville, NJ. I thank Phil Hossler, Arthur Schonheiter, Ariadne Rodriguez-Petrucelli, and Diane Hoffman for their support as well as the athletic trainers who participated in the survey.

REFERENCES

1. Alvarez OM, Mertz PM, Eaglstein WH. The effect of occlusive dressings on collagen synthesis and re-epithelialization in superficial wounds. *J Surg Res*. 1983;35:142–148.
2. Barnes R. New OSHA regulations: how they affect your training room. Presented at the 44th Annual Meeting and Clinical Symposium of the National Athletic Trainers' Association; June 9, 1993; Kansas City, MO.
3. Bassan MM, Dudai M, Shalev O. Near-fatal systemic oxygen embolism due to wound irrigation with hydrogen peroxide. *Postgrad Med J*. 1982;58:448–450.
4. Baxter CR, Rodeheaver GT. Interventions: hemostasis, cleaning, topical antibiotics, debridement, and closure. In: Eaglstein WH, ed. *Wound Care Manual: New Directions in Wound Healing*. Princeton, NJ: ConvaTec; 1990:71–82.
5. Becker GD. Identification and management of the patient at high risk for wound infection. *Head Neck Surg*. 1986;1:205–210.
6. Christie AL. The tissue injury cycle and new advances toward its management in open wounds. *Athl Train, JNATA*. 1991;26:274–278.
7. Davies JWL. Prompt cooling of burned areas: a review of benefits and the effector mechanisms. *Burns*. 1983;9:1–6.
8. Dyson M, Young S, Pendle CL, Webster D, Lang S. Comparison of the effects of moist and dry conditions on dermal repair. *J Invest Dermatol*. 1988;91:434–439.
9. Eaglstein WH. Preface In: Eaglstein WH, ed. *Wound Care Manual: New Directions in Wound Healing*. Princeton, NJ: ConvaTec; 1990:i.
10. Field CK, Morris DK. Overview of wound healing in a moist environment. *Am J Surg*. 1994;167:2S–6S.
11. Foresman PA, Payne DS, Becker DB, Lewis D, Rodeheaver GT. A relative toxicity index for wound cleansers. *Wounds*. 1993;5:226–231.
12. Gruber RP, Vistnes L, Pardoe R. The effect of commonly used antiseptics on wound healing. *Plast Reconstr Surg*. 1975;55:472–476.
13. Hedman LA. Effect of a hydrocolloid dressing on the pain level from abrasions on the feet during intensive marching. *Mil Med*. 1988;4:188–190.
14. Hermans MH. Clinical benefit of a hydrocolloid dressing in closed surgical wounds. *J Enterostom Nurs*. 1993;20:68–72.
15. Hermans MH. Hydrocolloid dressing versus tulle gauze in the treatment of abrasions in cyclists. *Int J Sports Med*. 1991;12:581–584.
16. Hermans MH, van Wingerden S. Treatment of industrial wounds with DuoDERM Bordered®: a report on medical and patient comfort aspects. *J Soc Occup Med*. 1990;40:101–102.
17. Horikoshi T, Balin AK, Eisinger M, et al. Modulation of proliferation in human epidermal keratinocyte and melanocyte cultures by dissolved oxygen. *J Invest Dermatol*. 1984;82:411. Abstract.
18. Hutchinson JJ, McGuckin M. Occlusive dressings: a microbiologic and clinical review. *Am J Infect Control*. 1990;18:257–268.
19. Jackson DS, Rovee DT. Current concepts in wound healing: research and theory. *J Enterostom Ther*. May-Jun 1988;15:133–137.
20. James SH, Watson CE. The use of Opsite, a vapour permeable dressing on skin graft donor sites. *Br J Plast Surg*. 1978;28:107.
21. Knighton DR, Hunt TK, Scheuenstuhl H, Halliday BJ, Werb Z, Banda MJ. Oxygen tension regulates the expression of angiogenesis factor by macrophages. *Science*. 1983;221:1283–1285.
22. Lawrence JC. Dressing and wound infection. *Am J Surg*. 1994;167:21S–24S.
23. LeVeen HH, LeVeen RF, LeVeen EG. The mythology of povidone-iodine and the development of self-sterilizing plastics. *Surg Gynecol Obstet*. 1993;176:183–190.
24. Lineaweaver W, Howard R, Soucy D, et al. Topical antimicrobial toxicity. *Arch Surg*. 1985;120:267–270.
25. Mellion MB, Fandel DM, Wagner WF, Kwikkel MA. Hydrocolloid dressings in the treatment of turf burns and other athletic abrasions. *Athl Train, JNATA*. 1988;23:341–346.
26. Mertz PM. Intervention: dressing effects on wound healing. In: Eaglstein WH, ed. *Wound Care Manual: New Directions in Wound Healing*. Princeton, NJ: ConvaTec; 1990:83–96.
27. Nemeth AJ, Eaglstein WH, Taylor JR, Peerson LJ, Falanga V. Faster healing and less pain in skin biopsy sites treated with an occlusive dressing. *Arch Dermatol*. 1991;127:1679–1683.
28. Rankin JM. Financial resources for conducting athletic training programs in the collegiate and high school settings. *J Athl Train*. 1992;27:345–349.
29. Rodeheaver G. Controversies in topical wound management. *Ostomy/Wound Manage*. 1988;20:58–68.
30. Rodeheaver G, Bellamy W, Kody M, et al. Bactericidal activity and toxicity of iodine-containing solutions in wounds. *Arch Surg*. 1982;117:181–186.
31. Schneider SL, Herbert LJ. Subcutaneous gas from hydrogen peroxide administration under pressure. *Am J Dis Child*. 1987;141:10–11.
32. Shannon ML, Miller B. Evaluation of hydrocolloid dressings on healing of pressure ulcers in spinal injury patients. *Decubitus*. 1988;1:42–46.
33. Stedman TL. *Stedman's Medical Dictionary*. 23rd ed. Baltimore, MD: Williams & Wilkins; 1976:662.
34. Tatnall FM, Leigh IM, Gibson JR. Assay of antiseptic agents in cell culture: conditions affecting cytotoxicity. *J Hosp Infect*. 1991;17:287–296.
35. US Department of Health and Human Services. *Clinical Practice Guideline for Pressure Ulcer Treatment*. Rockville, MD: AHCPR Publications; 1994:15–18.
36. Varghese MC, Balin AK, Carter M, Caldwell D. Local environment of chronic wounds under synthetic dressings. *Arch Dermatol*. 1986;122:52–57.
37. Yates DW, Hadfield JM. Clinical experience with a new hydrogel wound dressing. *Injury*. 1984;16:23–24.
38. Zamora JL. Chemical and microbiologic characteristics and toxicity of povidone-iodine solutions. *Am J Surg*. 1986;151:400–406.
39. Zitelli JA. Secondary intention healing: an alternative to surgical repair. *Clin Dermatol*. 1984;2:92–106.

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A Survey of Athletic Trainers as Health Care Advocates for Testicular and Breast Self-Examination in Athletic Populations

Lori Dewald, EdD, ATC, CHES; Candice Zientek, PhD, CCAAASP

ABSTRACT: There have been no previous studies of athletic trainers' educational practices regarding breast or testicular cancer, so we surveyed athletic trainers regarding: 1) the incidence of cancer among athletes, 2) educational practices concerning breast/testicular cancer, 3) educational practices regarding breast/testicular self-examination, 4) breast/testicular concerns of athletes, 5) breast self-examination and testicular self-examination among athletic trainers. A researcher-developed questionnaire was randomly distributed to athletic trainers at the 1994 NATA convention, and SPSS-X was used to analyze results, using Chi-square. One alarming finding was that 28% of athletic trainers surveyed had worked with an athlete who had cancer. Twenty-two percent of the athletic trainers surveyed reported that a female athlete had brought a breast concern to them, and 51% reported that a male athlete had brought a testicular concern to them. Most of the athletic trainers surveyed do *not* educate athletes about breast or testicular cancer and do *not* teach athletes about self-examination procedures, but do perform breast self-examination or testicular self-examination on themselves. Acting as a role model is an important step toward the education of athletes in our care, but more must be done. As health care professionals, athletic trainers must become more proactive, rather than reactive, when dealing with cancer prevention.

The athletic training profession has long focused on the prevention of athletic injuries—most frequently, musculoskeletal injuries. Secondary concerns include topics such as alcohol and other drug use, respiratory infections, etc. Often, athletic trainers are reactive to these secondary concerns when they should be proactive. There are numerous opportunities to have lifetime influences on the health care of athletes. The present study is an attempt to examine the incidence of breast and testicular cancer among athletes under the care of athletic trainers and to examine educational practices of athletic trainers regarding breast and testicular cancer. We hypothesize that athletic trainers do not teach breast and testicular self-examination to the athletes in their care.

METHODS

In an attempt to further examine this issue, 100 surveys were randomly distributed at the 1994 National Athletic Trainer's Convention in Dallas, TX. Seventy-five subjects (75%) responded to the questionnaire. Of those responding, 69 were certified athletic trainers (ATCs) and 6 were not certified (Table 1). Due to the small number of noncertified athletic trainers, only results from questionnaires completed by 69 ATCs were analyzed.

We encouraged subjects to complete the questionnaire at the conference, but several mailed their responses after the conference. We asked questions regarding educational practices with respect to the incidence of breast/testicular cancer among athletes in the athletic trainer's care, educational practices concerning breast/testicular cancer and breast/testicular self-examination, and the incidence of breast self-examination and testicular self-examination among athletic trainers themselves. They responded by answering yes or no to questions such as "Has an athlete in your care ever had cancer?" and "Do you educate your female athletes about breast cancer?" We also asked, "Do you perform either breast or testicular self-examination on yourself?"

Data were summarized using SPSS-X and answers given by male and female athletic trainers were compared using the Chi-square statistic. The level of significance used was $p < .05$.

RESULTS

Of the ATC respondents, 35 (51%) were male and 34 (49%) were female (Table 1). The majority (33 (48%)) were 20 to 30 years of age. Twenty-three (33%) were 31 to 40 years old; 9 (13%) were 41 to 50 years; and 4 (6%) were 51 to 60 years. The majority of respondents (50 (72%)) held master's degrees. Fifteen (22%) had earned bachelor's degrees, and 4 (6%) had earned doctorates. Most had earned their degrees in the 1980s (31 (45%)) or 1990s (28 (49%); Table 1).

Many of the respondents were college athletic trainers (34 (49%); Table 1). Others worked in high schools (14 (20%)), clinical settings (10 (15%)), or other settings (10 (15%)). One was apparently not working at the time. Of those working in a college setting, 12 were from National Collegiate Athletic Association (NCAA) Division I institutions, 6 were from Division II, and 11 were from Division III. Three were from National Association of Intercollegiate Athletics (NAIA) institutions, while 1 was from a National Junior College Athletic Association (NJCAA) institution, and 1 was from an NAIA + NCAA institution. Also, 10 different athletic training districts were represented.

Nineteen (28%) of the respondents (14 males, 5 females) had treated an athlete with cancer (Table 2). There was a

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Table 1. Characteristics of Respondents

Category	Respondents No. (%)
Certification	
Certified	69 (92.0)
Not certified	6 (8.0)
Gender	
Male	35 (50.7)
Female	34 (49.3)
Age	
20 to 30 years of age	33 (47.8)
31–40 years of age	23 (33.3)
41–50 years of age	9 (13.0)
51–60 years of age	4 (5.8)
Education	
Bachelor's	15 (21.7)
Master's	50 (72.5)
Doctorate	4 (5.8)
Date degree was conferred	
1960s	1 (1.4)
1970s	7 (10.1)
1980s	31 (44.9)
1990s	28 (40.6)
No response	2 (2.9)
Employment setting	
High school	14 (20.3)
College	34 (49.3)
Clinical	10 (14.5)
Other	10 (14.5)
No response	1 (1.4)
Division of college employees	
NCAA Division I	12 (35.3)
NCAA Division II	6 (17.6)
NCAA Division III	11 (32.4)
NAIA	3 (8.8)
NJCAA	1 (2.9)
NAIA + NCAA	1 (2.9)

significant difference between the male and female athletic trainers regarding this issue ($F[1,68] = 4.33$, $p < .05$); Table 3).

Most athletic trainers (59 (86%)) did not educate their female athletes about breast cancer (Table 2). No significant differences were found between male and female educational practices. Males (4) and females (5) were equally likely to educate female athletes about cancer (Table 2). The results regarding the education of male athletes were similar. Most ATCs (29 males and 30 females) said they did not educate their male athletes about testicular cancer (Table 2). No differences were found between male (6) and female (3) athletic trainers in this regard.

Only 5 athletic trainers (3 male and 2 female) had educated *both* male and female athletes about cancer. Most males (30) and most females (28) did not teach about cancer at all (Table 2).

Only 3 (1 male, 2 female) athletic trainers had taught their female athletes the techniques of breast self-examination (Table 2). Only 4 (3 males, 1 female) ATCs surveyed had taught testicular self-examination to their male athletes. No significant differences existed between male and female athletic trainers regarding self-examination procedures (Table 2).

Fifteen (22%) ATCs had had a female athlete bring a breast concern and 54 (78%) had had a male athlete bring a testicular concern to them. Although males and females were *not* significantly different in the number of female athletes who brought breast concerns to them (Table 2), male athletic trainers (24 (35%)) *were* more likely to have a male athlete come to them with a testicular concern than to female (10 (15%)) athletic trainers. Only 10 male ATCs had not treated a male athlete with a testicular concern, compared to 23 females who had not treated a male athlete with a testicular concern.

When asked whether they perform either breast or testicular self-examination on themselves, the majority (47) said yes. Female athletic trainers (29 (42%)) were significantly more likely to conduct self-examinations than male athletic trainers (18 (26%); $F[1,66] = 18.46$, $p < .05$)

DISCUSSION

Our hypothesis was proven. Most of the athletic trainers surveyed (87%) did not educate either their female or male athletes about cancer. The fact that only 7% of athletic trainers had educated *both* their male and female athletes about cancer is cause for alarm. It is also alarming that most athletic trainers do not teach either females or males self-examination procedures. These concerns could quite readily be remedied by the athletic training professionals who work with athletes on a daily basis if the practice of educating athletes were expanded to include breast self-examination and testicular self-examination education.

One alarming statistic is that almost 30% of the athletic trainers surveyed had worked with an athlete with some form of cancer; this alone should emphasize the need for education. This is a statistic that cannot be ignored. We recommend that future studies examining the incidence of breast and testicular cancer be conducted.

Education is especially important considering that the most common form of cancer in 15- to 34-year-old males is testicular cancer[1,3,6,7,9,10,13,17–19] accounting for 14% of cancer deaths for this age group.[1,18,19] There were 7,100 estimated new cases of cancer of the testes resulting in 370 deaths in the United States in 1995.[1] The incidence of testicular cancer in adolescents has been 1 in 10,000.[18] The earlier testicular cancer is recognized, the higher the survival rate: "prognosis of testicular cancer relates strongly to the stage of the disease at the time of discovery."[6] Overall, the 5-year rate of survival from testicular cancer has increased from 72% in 1975 to 91% in 1995.[1] Nonmetastasized cancers have a 5-year survival rate of 98%, while metastasized testicular cancer has a survival rate of 60% to 82%.[1,7,9,18] Early detection leads to higher cures, and "the only way to detect cancer in an early stage is for men to examine themselves regularly."[7]

Testicular self-examination performed correctly and monthly has been shown to decrease the number of testicular cancer deaths.[2,4,5,8,10–12,14] Yet, very few adolescent males practice testicular self-examination. Studies have shown that between 2% and 7% of males perform testicular self-

Table 2. Responses of Athletic Trainers by Gender to Questions Regarding Breast/Testicular Cancer

Question	Female No. (%)	Male No. (%)
Has an athlete in your care ever had cancer?		
Yes	5* (7.3)	14 (20.3)
No	29 (42.0)	21 (30.4)
Do you educate your female athletes about breast cancer?		
Yes	5 (7.3)	4 (5.8)
No	28 (40.6)	30 (43.5)
No answer	1 (1.4)	1 (1.4)
Do you educate your male athletes about testicular cancer?		
Yes	3 (4.4)	6 (8.7)
No	30 (43.5)	29 (42.0)
No answer	1 (1.4)	
Do you teach your female athletes the techniques of breast self-examination?		
Yes	2 (2.9)	1 (1.4)
No	31 (44.9)	33 (47.8)
No answer	1 (1.4)	1 (1.4)
Do you teach your male athletes the techniques of testicular self-examination?		
Yes	1 (1.4)	3 (4.4)
No	32 (46.4)	32 (46.4)
No answer	1 (1.4)	
Have you ever had a female athlete bring a breast concern to you?		
Yes	8 (11.6)	7 (10.1)
No	26 (37.7)	28 (40.6)
Have you ever had a male athlete bring a testicular concern to you?		
Yes	10 (14.5)	24* (34.8)
No	23 (33.3)	10 (14.5)
No answer	1 (1.4)	1 (1.4)
Do you perform either breast or testicular self-examination on yourself?		
Yes	29 (42.0)	18 (26.1)
No	4 (5.8)	17 (24.7)
No answer	1 (1.4)	

* Significance $< .05$

examination regularly.[18,19] Vaz et al[19] studied 1,286 ninth-grade boys and found that 7% practiced testicular self-examination. A testicular cancer curriculum was designed and implemented and found to be effective as 585 of the trained subjects practiced testicular self-examination posttraining. The most recent study of high school males reported that 75% of the 1,364 surveyed had been to a physician during the past 15 months, and yet only 3.6% had performed testicular self-examination.[18] In a study of college men, 2% performed testicular self-examination.[11,18] Goldenring[7] suggests that health care professionals should instruct males in testicular self-examination. And, if athletic trainers are to be considered health care providers, then we should be teaching testicular self-examination to the athletes in our care.

Reaction to testicular self-examination education programs is not without controversy. Some researchers support the implementation of high school testicular cancer programs,[7,10,18] while others question the financial cost-benefit ratio (the amount of anxiety produced due to the fear induced and medical expenses such as the cost of diagnostic procedures, doctor's visits, etc).[6] The fact that testicular self-examination education should not be taught because of fear has been countered by Vaz et al[18] who reported that the majority of their subjects "were already anxious about testicular cancer, felt it was a powerful disease and were afraid of getting it, but felt that it was unlikely to happen to them."

Breast cancer in both men and women usually occurs later in life (after the age of 35) than testicular cancer (15 to 34 years). The American Cancer Society[1] data on female breast cancer for 1995 include 182,000 estimated new cases of breast cancer resulting in 46,000 estimated deaths in women. The mortality rate for breast cancer is "an estimated 46,240 deaths (46,000 in women and 240 in men); breast cancer is the second major cause of cancer death." The 5-year survival rate has increased from 78% fifty years ago to 94% in 1995. If breast cancer has spread regionally (when diagnosed), the 5-year survival rate drops to 73%, and if the cancer is metastasized, the rate is 18%.

The incidence of breast cancer in children and adolescents is infrequent, as breast cancer occurs only rarely before the age of 35.[6] However, over 80% of breast masses are found by women themselves,[7] so proponents of testicular and breast self-examination education propose including these areas in high school and college classes and reviewing the technique at every health maintenance examination throughout life, so that both men and women will develop life-long self-examination practices.[6]

Table 3. Breast and Testicular Cancer and Self-examination Resource Materials

NATIONAL CANCER INSTITUTE: 1–800-4-CANCER
National Cancer Institute. *What You Need to Know About Breast Cancer.* 1992.
National Cancer Institute. *What You Need to Know About Testicular Cancer.* 1992.
AMERICAN CANCER SOCIETY: 1–800-ACS-2345
American Cancer Society. *How to Examine Your Breasts.* 1994.
American Cancer Society. *How to Examine Your Testicles.* 1994.

It must, however, be pointed out that conflicting opinions exist regarding whether lifelong practices of breast self-examination result in earlier diagnosis, whether early breast cancer detection prolongs life, or whether the process merely increases anxiety.[6] In 1979, the Canadian Task Force on Periodic Health Examination[20] questioned the teaching of breast self-examination and concluded that "the available evidence did not warrant inclusion of breast self-examination and identified the maneuver as a priority for further research." Recent re-evaluation conducted by the task force has not changed the recommendation.[20] In 1983, the World Health Organization stated that "as breast cancer is very uncommon before the age of 35 or 40, it would be inappropriate and wasteful of resources to enroll younger women, unless it were shown that early training increased compliance at later ages, or that knowledge of breast self-examination in younger women led to an increase in the extent to which older women practiced it by diffusion of knowledge from one generation to another."[20] Those advocating breast self-examination education include The American Cancer Society and the Surgeon General of the United States. The American Cancer Society recommends breast self-examination monthly for women who are 20 years of age or older.[1] The Surgeon General stated that breast self-examination is the most effective method of detecting breast cancer at early treatable stages.[15] In a 1994 study, Stevens et al[16] supported breast self-examination as "an important screening behavior for the early detection of breast cancer."

Athletic trainers can educate athletes through an educational program that may begin with a preseason physical examination, followed by team and individual educational sessions, and posting pamphlets and/or posters in the athletic training centers and locker rooms. Local American Cancer Societies are excellent sources for free cancer education materials and educational presentations. Another resource is the National Cancer Institute. Table 3 provides the national addresses and details of some of the resource materials from the American Cancer Society and National Cancer Institute.

Educators need to become more involved in the education of the athletes in their care. Both male and female athletic trainers need to educate their athletes. There is a very easy solution to this problem; the answer is education.

It is a step in the right direction for most athletic trainers to conduct their own self-examinations. The next step is for the athletic trainers to relay the information to athletes. The importance of self-examination must be taught by athletic trainers. Acting as a role model is an important step toward the education of the athletes in our care, but more must be done.

REFERENCES

1. American Cancer Society. *Cancer Facts and Figures.* Atlanta, GA: American Cancer Society; 1995;6–10.
2. Cavanaugh R. Genital self-examination in adolescent males. *Am Fam Physician.* 1985;28:199–201.
3. Dachs R, Garb J, White C, Berman J. Male college students' compliance with testicular self-examination. *J Adolesc Health.* 1989;10:295–299.
4. Dieckmann K, Becker T, Bauer H. Testicular tumors: presentation and role of diagnostic delay. *Urol Int.* 1987;42:241–247.
5. Einhorn L. Cancer of the testis: a new paradigm. *Hosp Pract.* 1986;21: 165–178.
6. Goldbloom R. Self-examination by adolescents. *Pediatrics.* 1985;76:126–128.
7. Goldenring J. Equal time for men: teaching testicular self-examination. *J Adolesc Health.* 1986;7:273–274.
8. Goldenring J. Teaching testicular self-examination to young men. *Contemp Pediatr.* 1985;2:73–78.
9. Goldenring J, Purtell E. Knowledge of testicular cancer risk and need for self-examination in college students: a call for equal time for men in teaching of early detection techniques. *Pediatrics.* 1984;74:1093–1096.
10. Klein J, Berry C, Felice M. The development of a testicular self-examination instructional booklet for adolescents. *J Adolesc Health.* 1990;11:235–239.
11. Marty P, McDermott R. Three strategies for encouraging testicular self-examination among college age males. *J Am Coll Health.* 1986;34: 253–258.
12. National Cancer Institute. *Testicular Self-examination.* Bethesda, MD: National Cancer Institute; 1994. US Dept of Health and Human Services Publication NIH 385-2636.
13. National Cancer Institute. *Testicular Cancer.* Bethesda, MD: National Cancer Institute; 1990. US Dept of Health and Human Services Publication NIH 385-2636.
14. Prout G, Griffin P. Testicular tumors: delay in diagnosis and influence on survival. *Am Fam Physician.* 1984;29:205–209.
15. Schlueter L. Knowledge and beliefs about breast cancer and breast self-examination among athletic and nonathletic women. *Nurs Res.* 1982; 31:348–353.
16. Stevens V, Hatcher J, Bruce B. How compliant is compliant? Evaluating adherence with breast self-examination position. *J Behav Med.* 1994;17: 523–534.
17. Testicular self-exam. *Postgrad Med.* July 1992;74.
18. Vaz R, Best D, Davis S. Testicular cancer: adolescent knowledge and attitudes. *J Adolesc Health.* 1988;9:474–479.
19. Vaz R, Best D, Davis S, Kaiser M. Clinical laboratory observations: evaluation of a testicular cancer curriculum for adolescents. *J Pediatr.* 1989;114:150–153.
20. World Health Organization. *Self-examination in the Early Detection of Breast Cancer.* A Report on Consultation on Self-examination in Breast Cancer Early Detection Programmes. Geneva, Switzerland: World Health Organization; Nov 17–19, 1983.

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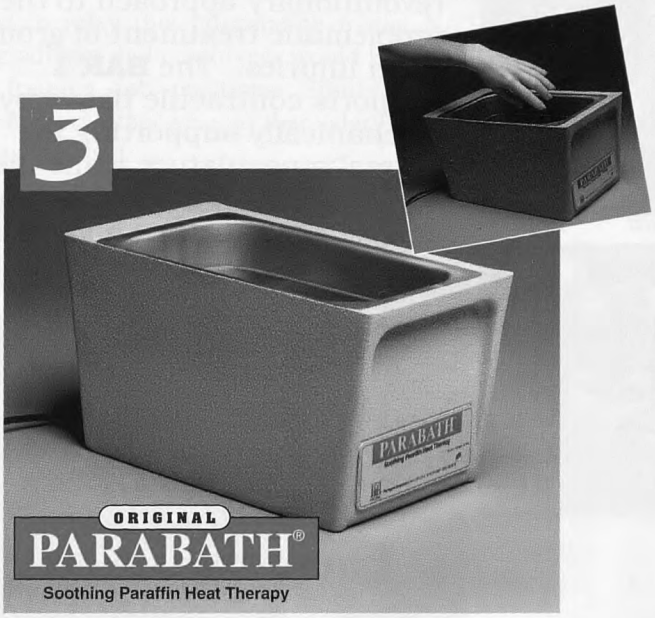

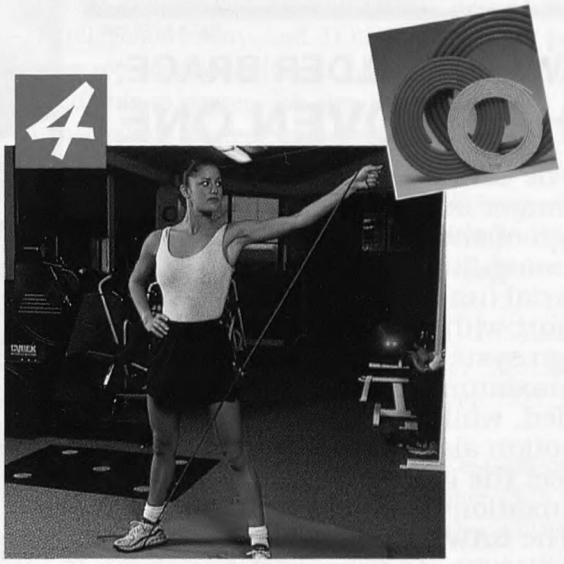

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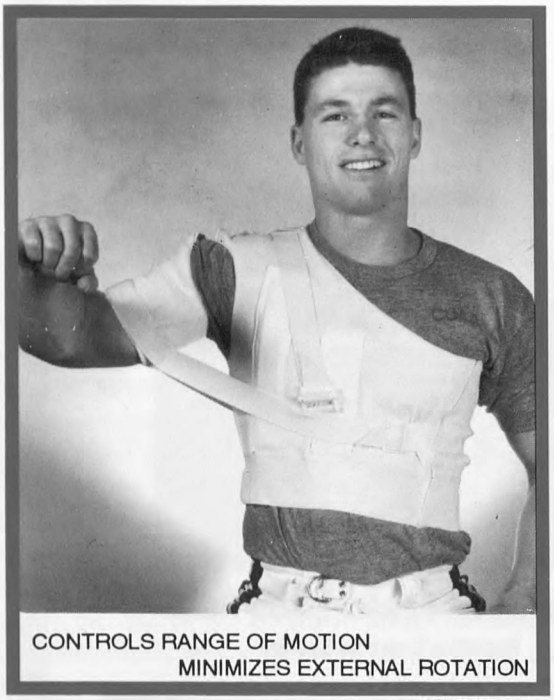

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1994 Entry-Level Athletic Training Salaries

Crayton L. Moss, EdD, ATC

ABSTRACT: In this study, I examined salaries for entry-level positions in athletic training during the year 1994. An entry-level position was defined as a position to be filled with an athletic trainer certified by the NATA, with no full-time paid employment experience. According to the "Placement Vacancy Notice" (NATA, Dallas, TX) and "BYLINE" (Athletic Trainer Services, Inc, Mt Pleasant, MI), there were 432 entry-level vacancies in hospital/clinics, college/universities, and high school settings. A total of 271 surveys (63%) were returned. Overall, beginning salaries for entry-level athletic training positions were $23,228 (±$3,177) for a bachelor's degree and $25,362 (±$3,883) for a master's degree. A stipend ($4,216 ± $2,039) was included in 86% of the high school positions. The term of contract for high school was usually a 10-month position (10.0 ± .9 months), hospital/clinic, 12-months (11.7 ± .7 months), while the college/university varied from 9 to 12 months (10.5 ± 1.2 months). Also included in the study was fringe benefit information: pension (other than Social Security), life, medical, dental, and vision insurance. Continued studies are recommended to establish salary norms and trends for entry-level positions so that athletic trainers will understand what monetary compensation to expect for their services.

My interest in entry-level athletic training salaries began when I read an article by Gieck[1] in 1986. I began this longitudinal study with two pilot studies and continued my studies during the years 1992 and 1994.[3–5] Since the 1992 article, there has been little information concerning entry-level salaries for athletic trainers.[5]

The purpose of this study was to examine the salaries for entry-level positions in athletic training during the year 1994 and to relay this information to the NATA so that college graduates and employers would have salary data for athletic training job positions. Similar studies will be conducted every other year so that salary norms and trends may be established.

METHODS

An entry-level position was defined as an athletic trainer, certified by the NATA, with no full-time paid employment experience. According to the "Placement Vacancy Notice" (NATA, Dallas, TX) and "BYLINE" (Athletic Trainer Services, Inc, Mt Pleasant, MI), there were 432 entry-level vacancies in hospital/clinics, college/universities, and high school settings during 1994. The "Placement Vacancy Notice" is published at least monthly, while "BYLINE" is available quarterly. Job descriptions are included in the notice. No other sources of athletic training vacancies were used for this study.

A survey was designed and mailed, with a return self-addressed stamped envelope, after each vacancy notice was received, to those whose job descriptions did not specify that prior job experience was necessary. An address list was compiled and checked before each mailing to determine new position vacancies from each source. Only one survey was sent to a job site for each new vacancy. The survey was coded individually so that a second mailing could be sent if needed. An abstract of the results was sent for each vacancy. The survey topics included: position available; compensation for bachelor's degree, master's degree, and stipend; term of contract; weekly workload; pay scale availability; raise percentage; and fringe benefits.

RESULTS

Of the 432 surveys mailed, 271 (63%) were returned. The positions were divided into three different sites: 1) hospital/clinic, 2) college/university, and 3) high school. Job position salaries were recorded according to job site. Table 1 shows the salaries according to degree, job site, and position for 1994.

For the bachelor's degree entry-level position,* the highest to lowest job position salaries were: 1) high school—athletic trainer/teacher ($25,963 ± $2,474); 2) hospital/clinic—athletic trainer/athletics ($23,967 ± $2,965); 3) hospital/clinic—athletic trainer ($23,847 ± $2,608); 4) college/university—head athletic trainer ($23,101 ± $4,585); 5) college/university—athletic trainer/teacher ($22,136 ± $3,522); 6) college/university—assistant athletic trainer ($21,966 ± $3,664); and 7) high school—athletic trainer ($21,584 ± $3,992).

For the master's degree, the highest to lowest job position salaries were: 1) hospital/clinic—athletic trainer ($28,117 ± $2,382); 2) high school—athletic trainer/teacher ($28,017 ± $3,073); 3) college/university—athletic trainer/teacher ($25,822 ± $5,139); 4) hospital/clinic—athletic trainer/athletics ($25,782 ± $2,963); 5) college/university—head athletic trainer ($25,706 ± $6,820); 6) college/university—assistant athletic trainer ($23,676 ± $3,991); and 7) high school—athletic trainer ($23,000 ± $2,943).

Overall mean salaries for entry-level athletic training positions were $23,228 (±$3,177) for a position requiring a bachelor's degree and $25,362 (±$3,883) for a position requiring a master's degree.

All but 5 of the 35 high school athletic trainer/teacher positions included an average stipend of $4,216 (±$2,039).

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*All high school salaries include a stipend, if an additional stipend is given for athletic training.

Table 1. 1994 Entry-Level Salaries According to Degree, Job Site, and Position Along With % Change From 1992 Study (Mean ± SD)

		Bachelor's Degree		Master's Degree	
Position	(n)	$\bar{x}$ ± SD	Change	$\bar{x}$ ± SD	Change
Hospital/clinic					
Athletic Trainer	(17)	$23,847 ± $2608	+3.7%	$28,117 ± $2382	+11.1%
Athletic Trainer/Athletics	(114)	23,967 ± 2965	+5.4%	25,782 ± 2963	+1.8%
Total	(131)	23,949 ± 2904	+4.9%	26,032 ± 2893	+2.8%
College/university					
Head Athletic Trainer	(16)	23,101 ± 4585	−3.9%	25,706 ± 6820	−3.3%
Athletic Trainer/Teacher	(43)	22,136 ± 3522	−2.5%	25,822 ± 5139	+5.7%
Assistant Athletic Trainer	(35)	21,966 ± 3664	+12.9%	23,676 ± 3991	+3.6%
Total	(94)	22,262 ± 3752	+8.7%	25,035 ± 5113	+5.6%
High school					
Athletic Trainer	(11)	21,584 ± 3992	−2.5%	23,000 ± 2943	−19.1%
Athletic Trainer/Teacher	(35)	25,963 ± 2474	−2.9%	28,017 ± 3073	−2.2%
Total	(46)	24,892 ± 2887	−4.1%	27,444 ± 3036	−3.9%
Salary summary					
Total	(271)	23,228 ± 3177	+0.5%	25,362 ± 3883	+0.6%

Only 1 of the 11 high school/athletic training positions requiring no teaching assignment received a stipend of $5,125. Five of the 43 college/university athletic training/teaching positions included an average stipend of $6,400 (±$3,361). No other college/university position included a stipend with the annual salary. Five of the 114 hospital/clinic athletic training/athletics positions also included a stipend of $3,630 (±$2,845) with their annual salary. There was no stipend included in the annual salary of the 17 hospital/clinic athletic training positions.

The most common term of contract for high school was a 10-month position (28 (60%); $\bar{x}$ = 10.0 ± .9) with the remaining contracts at 9 and 12 months, 11 (24%) and 7 (16%), respectively. Of the hospital/clinic vacancies, 122 (93%) had 12-month contracts ($\bar{x}$ = 11.7 ± .7). The college/university contract varied over 9-month (17 (18%)), 10-month (39 (42%)), and 12-month positions (38 (40%); $\bar{x}$ = 10.5 ± 1.2).

The average hours worked per week for college/university positions was 49.2 ± 8.3 hours, 48.9 ± 10.2 hours for the high school positions, and 44.7 ± 5.9 hours for the hospital/clinical vacancies.

Thirty-two (70%) of the high school positions had an established pay scale with an increase of 3.32% pay raise for the year 1992, 3.02% in 1993, and a projected increase of 3.80% for 1994.[4,5] The average raise over the last 3 years was 3.38%. Twenty-seven (29%) of the college/university vacancies have a pay scale with an increase of 3.36% in 1992, 3.62% in 1993, and a projected increase of 3.67% for the year 1994. The average raise over the last 3 years was 3.55%. Approximately half (64 (49%)) of the hospital/clinical positions indicated they had an established pay scale. They also indicated a 4.66% increase of pay in 1992, 4.66% in 1993, and a projected 1994 increase of 4.54%. The average raise over the last 3 years was 4.62%.

Fringe benefits included pension (other than Social Security), life, medical, dental, and vision insurance. The majority of the positions had a pension plan other than Social Security: high school, 41 (89%); college/university, 74 (79%); and hospital/clinic, 84 (64%). The majority also had life and medical insurance: high school, 33 (72%) and 42 (91%); college/university, 33 (79%) and 42 (96%); and hospital/clinic, 111 (85%) and 128 (98%); respectively. Dental and vision insurance recorded varied information: high school, 28 (61%) and 4 (9%); college/university, 45 (48%) and 32 (34%); and hospital/clinic, 94 (72%) and 34 (26%); respectively.

DISCUSSION

Since my first article in 1992, in which I reported entry-level athletic training salaries, I have received numerous phone calls from both administrators and certified athletic trainers concerning salary ranges that athletic trainers may expect for their services.[4,5] The only studies which could be located concerning athletic trainers' salaries were follow-up studies after certification and job placement.[1,6,7] These were not unusual studies when compared to the physical therapy profession.[2] The follow-up studies provide valuable information concerning the athletic training profession, but they do not answer a student's question concerning their beginning salary upon graduation. Other than my own studies, I know of only one other survey which indicated a range of salaries for athletic trainers.[1]

Hospital/Clinical

Most of the job vacancies sited at the hospital/clinical setting (114 (87%)) require an athletic sport assignment at a mean salary of $23,949 (±$2,904) for the BS, and an

average salary of $26,032 (±$2,893) for a MS (Table 1). This was an increase of 4.9% and 2.8%, respectively, from the 1992 study.[4,5] The master's degree hospital/clinic athletic trainer, without athletic/sport assignment, boasted the highest salary in 1994 at $28,117 (±$2,383), Table 1. This was an increase of 11.10% from those salaries reported in 1992.[4,5] Either a bachelor's or a master's degree is sufficient to acquire a job in this setting. On average, the MS degree recipient will earn $2,083 or 8.7% more than the BS graduate. When comparing these salaries to the other job positions, one must remember that a stipend is usually not included in the annual salary and that this salary represents a 12-month contract. Approximately half (64 (49%)) of these positions indicated they had an established pay scale. The average hours worked per week (44.7 ± 5.9) is only 4 and 5 hours less than the other two settings (high school and college/university, respectively), although standard deviation is almost doubled for both of the other settings. The fringe benefits were the best for these positions, when compared with the other vacancies. It stands to reason that a medical facility would have superior benefits.

Using the pay raises recorded from the 1994 survey for the last 3 consecutive years, projected salaries for the hospital/clinical vacancies are $25,055 (BS) and $27,234 (MS) for 1995, and $26,213 (BS) and $28,493 (MS) for 1996 (Table 2).

Table 2. Entry-Level Salary Projections (Based on % Increases From 1994 Salaries)

Position	$\bar{x}$ % Salary Increase per year	1996 Projected Salaries Bachelor's	Master's
Hospital/Clinic			
Athletic Trainer	+3.81	$25,698	$30,300
Athletic Trainer/Athletics	+4.72	26,282	28,273
Total	+4.62	26,213	28,493
College/University			
Head Athletic Trainer	+3.64	24,813	27,611
Athletic Trainer/Teacher	+3.96	23,924	27,907
Assistant Athletic Trainer	+3.06	23,331	25,147
Total	+3.55	23,871	26,844
High School			
Athletic Trainer	+3.32	23,041	24,552
Athletic Trainer/Teacher	+3.39	27,753	29,949
Total	+3.38	26,603	29,331
Salary Summary			
Total	+4.01	25,128	27,437

High School

The high school athletic trainer/teacher recorded the highest beginning salary for the bachelor's degree at $25,963 (±$2,474). (See Table 1.) This remains consistent with the 1992 study.[4,5] The MS degree was ranked second (highest to lowest salaries) at $28,017 (±$3,073), behind the hospital/clinic athletic training MS position. These positions also showed the highest percentage (70%) having an established pay scale. According to the results, the majority of the high school positions had a 10-month contract. This was a 14% decrease from the 1992 study. The average hours worked per week was 48.9 (±10.2). This is more than the hospital/clinic positions but very similar to the college/university positions. Fringe benefits for these positions were the lowest recorded for this study. Most of the benefits are available but paid by the employee. This study was concerned with what benefits are paid by the employer.

Projected salaries for the high school vacancies are $25,733 (BS) and $28,371 (MS) for 1995, and $26,603 (BS) and $29,331 (MS) for 1996 (Table 2).

College/University

An entry-level position for the college/university setting normally requires a master's degree. Even though Table 1 lists annual salaries with a bachelor's degree, a master's degree is recommended if a certified athletic trainer is pursuing these positions. One respondent commented, "Job market as it is, a master's degree becomes entry-level for a position in Division I athletics." In the 1992 study, the most common vacancy at the college/university setting was as an assistant athletic trainer at a mean salary of $19,450 ± $2,710 with a bachelor's degree and $22,858 ± $3486 with a master's.[4,5] This was the lowest paid position.[4,5] In 1994, salary with a bachelor's degree increased by 12.9% ($21,966 ± $3,664) and by 3.6% with a master's degree ($23,676 ± $3,991), Table 1.[4,5] There were more recorded vacancies for the athletic trainer/teacher in 1994 than 1992 (15% increase), and with higher pay (5.7%).[4,5] Mean salary for athletic trainer/teacher positions with a master's degree was $25,822 (±$5,139) at the college/university (Table 1). There are still few positions available as the head athletic trainer at the college/university level. Head athletic trainer positions had a mean salary of $25,706 (±$6,820), Table 1. The head athletic training position showed a decrease of 3.3%. Although most vacancies at the college/university setting had a teaching responsibility (43 (46%)), only 27 (29%) of the positions had an established pay scale. Fringe benefits were better than the high school positions but not the hospital/clinic. The term of contract for these positions varied from 9 to 12 months; the most common was 10 months (39 (42%)). In 1992, the most common term of contract was 12 months (24 (49%)).[4,5] The average hours worked per week was 49.2 (±8.3), the highest among positions studied.

Projected salaries for the master's degree college/university vacancies are $25,924 for 1995 and $26,844 for 1996 (Table 2). Even though this category, college/university, had the greatest increases of salary over the last 2 years, it is still the lowest paid position with the highest hours worked per week.

When I wrote the 1992 article, I was concerned about the low compensation for assistant athletic trainers at colleges and universities. I am pleased to report that an increase in salaries is occurring in both this specific position and in the hospital/clinic position overall. There is not as much discrepancy in the salaries as when Weidner[8] wrote, "Many

ATCs also are guilty of accepting embarrassingly low salaries." One of the surveys had this comment, "I'm the director, not the owner. I'm an ATC/PT and I didn't want the ATCs to undercut themselves. I interviewed around 20 ATCs. The three I hired (ATC/MS) were right out of graduate school." The three requested salaries between $20,000 and $27,000, but were hired at $25,000 to $28,000, which is in line with the 1994 survey of $25,782.

The purpose of this study was to examine the beginning salaries for entry-level positions during 1994 and to relay this information to the NATA so that college graduates and employers would have salary data for athletic training job positions. A similar study will be conducted in 1996 to help establish salary norms and trends for entry-level positions so that athletic trainers will understand what monetary compensation to expect for their services.

ACKNOWLEDGMENTS

Special thanks to the NATA Research & Education Foundation (NATA-REF) for granting the funds to make this 1994 study possible. A grant has been proposed to the NATA-REF for the 1996 study to continue this longitudinal study concerning the norms and trends of entry-level athletic trainers' salaries.

REFERENCES

1. Gieck J, Lephart S, Saliba E. NATA certification: a 5 & 10 year follow-up. *Athl Train, JNATA*. 1986;21:120–121,163.
2. Guccione AA, Jette AM. Regional differences in physical therapists' incomes. *Phys Ther*. 1984;64:1209–1213.
3. Moss CL. 1994 entry-level athletic trainer salaries. *Athl Train, JNATA*. 1995;30(suppl):S13. Abstract.
4. Moss CL. 1992 entry-level athletic trainer salaries. *NATA News*. 1994; Oct:14–15.
5. Moss CL. 1992 entry-level athletic trainer salaries. *J Athl Train*. 1994;29: 205–207.
6. Paris D. A certified athletic therapist's questionnaire: five year update. *J Can Athl Ther Assoc*. April 1991;22–25.
7. Paris D. Year of the CAT: results from a questionnaire for certified athletic therapists. *J Can Athl Ther Assoc*. 1987;1:6–7:9.
8. Weidner T. It's up to ATCs to obtain higher salaries. *NATA News*. April 1990;2:4.

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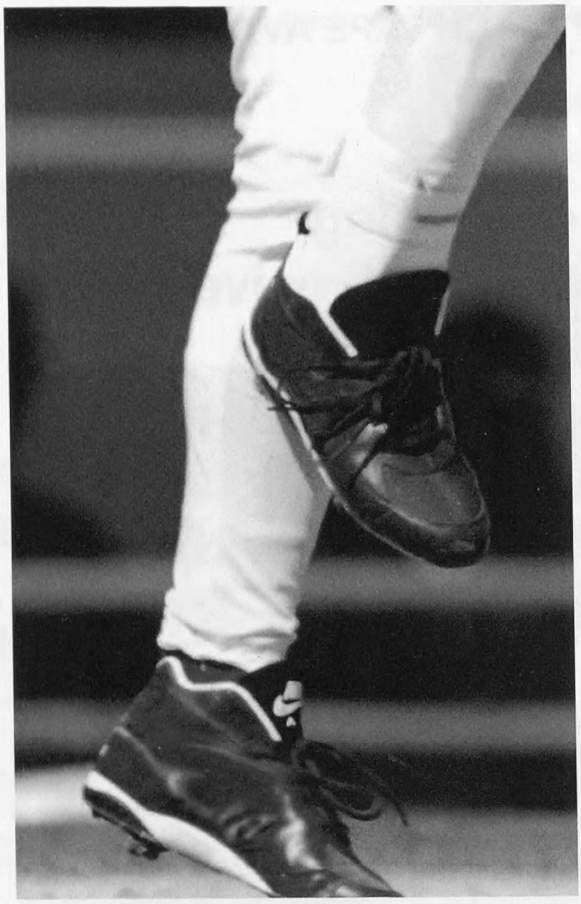

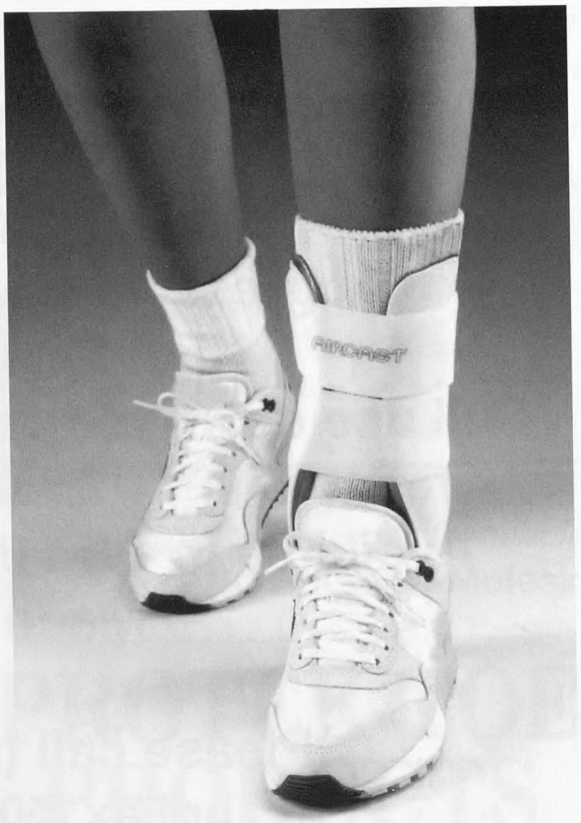

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The Incidence of Spearing During a High School's 1975 and 1990 Football Seasons

Jonathan F. Heck, MS, ATC

ABSTRACT: Spearing and head-first contact in football pose significant risks of cervical spine injury and concussion. Reduction in the number of catastrophic head and neck injuries in football has been attributed to the 1976 rule change banning spearing. In this study, I examine the incidence of spearing before and after the rule change. I reviewed 18 game films of a New Jersey high school football team (9 from 1975 and 9 from 1990) to determine the incidence of all types of spearing by ball carriers and tacklers. The cumulative incidence was 1/2.5 plays for 1975 and 1/2.4 plays for 1990. Over 14 ball carrier spears and over 26 tackler spears occurred per game for both seasons. Spearing by running backs increased during the 1990 season, but the overall incidence of ball carrier spearing did not change. Tacklers were more likely to spear when a ball carrier speared and the incidence of concurrent tackler spearing increased significantly during the 1990 season. Independent tackler and defensive linemen spearing, however, decreased. Linebackers and defensive backs accounted for the most spears among tacklers. Overall, it does not appear that the rule change had a favorable impact on the incidence of spearing.

Spearing and head-first contact pose significant risks of catastrophic spine injury and concussion for football players.[2,4,6–9,15,20–23,26,28–36] Since the 1976 rule change banning spearing in high school football, there has been a large reduction in the incidence of catastrophic head and neck injuries.[20–23,28–33] Many authors[26,20–23,28–34] attribute the reduction to the rule change. However, exactly why the rule change has been effective has not been explained.

One possible explanation is that the rule change caused a decrease in the incidence of spearing. A reduced incidence of the mechanism of injury would explain a reduction in axial loading injuries to the cervical spine. The purpose of this study was to gain insight into this explanation by comparing the incidence of spearing between two high school football seasons—one before and one after the rule change.

METHODS

Data were obtained from the observation of two varsity football seasons from a New Jersey high school. I observed nine regular season game films from the 1975 season and nine from the 1990 season. The selected school is representative of a highly competitive and skilled football team. The program has had the same head coach since 1972 and during that time the team has compiled a record of 140 wins, 68 loses, and 4 ties. During the 1975 season, the team was undefeated and won a state championship. Two players from that team went on to play in the National Football League. During the 1990 season, the team lost in the state playoffs.

I chose the 1990 season because it was the last complete season recorded on 16-mm film. I found that film is superior to VHS tape in clarity, which is crucial in accurately judging helmet position during contact. I did not include blocker spearing because all blockers are not always in view on the game film. The films normally follow the ball carrier, which often leaves contact not associated with tackling the ball carrier out of view.

I viewed these films on a 16-mm Kodak projector with a Kodak .625 enhancement lens. The projector has standard slow motion and reverse mode capabilities. Each game was graded individually on its own score sheet. The score sheet consisted of total plays, ungradable plays, independent tackler spears, ball carrier spears, and concurrent tackler spears. Data were collected and reported for both teams in each game. Therefore this study included 20 different football teams.

The methods for this study have been reported previously.[13] For continuity, I will include a brief overview of the similar methods. Ball carrier and tackler spearing were defined as lowering the head (unintentional or intentional) and initiating contact with the crown of the helmet. Incidents of ball carrier spearing were tabulated if a ball carrier speared a tackler or potential tackler. Incidents of concurrent tackler spearing were tabulated when a tackler or potential tackler speared a ball carrier who was also spearing. This was previously defined as concurrent defensive spearing.[13]

I also included incidents of independent tackler spearing in this study. An incident of independent tackler spearing was tabulated only when a tackler or potential tackler speared a ball carrier who was not spearing. This included a receiver or running back on an incomplete pass. This study only included spearing that was directly associated with a ball carrier. Spearing by blockers or defensive contacts away from the ball were excluded.

In viewing the game films, I only included plays in which a ball was carried.[13] A single play could include numerous contacts between tacklers and a ball carrier (broken tackles, simultaneous tacklers, etc). More than one spear could also occur on a single play. A play was considered ungradable when contact by the ball carrier and tackler(s) could not be seen on the game film. I tabulated the type of ball carrier play as a running play, complete pass, incomplete pass, kick return, or turnover.

I tabulated incidents of spearing by position. Ball carriers were placed in one of six categories: running back, quarter-

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back, receiver, kick returner, offensive lineman on a fumble advance, or defensive player on a fumble or interception return. A player's starting position determined his category. For example, if a running back caught a pass and speared a tackler, I considered it a spear by a running back on a completed pass play.

For defensive players, the positional categories included lineman, linebacker, defensive back, special team, or offensive player on a fumble advance or interception. A 5-4 defense was considered to have five linemen, two linebackers, and four defensive backs. I considered a 4-3 defense to have four linemen, three linebackers, four defensive backs and a 4-4 defense to have four linemen, four linebackers, and three defensive backs.

An independent *t* test was used for data comparison of spearing incidents and positional spearing during the 1990 and 1975 seasons.

RESULTS

Data categories include ball carrier spearing, concurrent tackler spearing, independent tackler spearing, total tackler spearing, and all spearing incidents. Total tackler spearing = concurrent tackler spearing + independent tackler spearing. All spearing incidents = ball carrier spearing + concurrent tackler spearing + independent tackler spearing.

1990 Season

The totals for the nine observed games during the 1990 season are shown in Table 1. There were an average of 105 ± 8.8 plays per game; 95% were gradable. The breakdown of types of plays and the number of those plays that included at least one spear are shown in Table 2 for both seasons.

The mean score for all spearing incidents per game was 44.2 ± 7.2. The mean score was 26.8 ± 4.3 for incidents of total tackler spearing per game and 15.2 ± 4.3 for independent tackler spearing. The distribution of spears by defensive players are shown in Table 3 for both seasons.

The mean score for incidents of ball carrier spearing was 17.3 ± 5.8 per game. The distribution of ball carrier spears by positions for both seasons are shown in Table 4. The mean score for concurrent tackler spearing was 11.6 ± 2.6 per game.

Of a total of 945 plays, there was an incident of spearing on 398 plays (42%). Ball carriers speared on 156 plays (17%) and tacklers speared on 242 (26%). The cumulative incidences of spearing are shown in Table 5 for both seasons.

1975 Season

The totals for the nine observed games during the 1975 season are shown in Table 1. There were an average of 109 ± 8.9 plays per game; 96% were gradable. The mean score for all spearing incidents per game was 43.2 ± 8.7. The mean score for incidents of total tackler spears was 28.3 ± 5.5 and 21.4 ± 3.9 for independent tackler spearing.

For ball carrier spearing, the mean score was 14.9 ± 3.8 incidents per game. The mean score for incidents of concurrent tackler spearing was 6.8 ± 3.8 per game.

There was an incident of spearing on 389 of 982 of the total plays (40%). Ball carriers speared on 134 plays (14%) and tacklers speared on 255 (26%). There was no difference in all spearing incidents among the 1990 and 1975 seasons ($t[16] = .27$, $p > .05$). There also was no difference in the number of ball carrier spears between the two seasons ($t[16] = 1.38$, $p > .05$). There was a significant increase during 1990 in incidents of concurrent tackler spearing ($t[16] = 3.12$, $p < .05$). During 1990 there was a significant decrease in independent tackler spearing ($t[16] = 3.88$, $p < .05$).

By ball carrier position, spearing by running backs increased during the 1990 season ($t[16] = 2.31$, $p < .05$). There were no differences between the seasons for quarterbacks ($t[16] = 1.04$, $p > .05$), receivers ($t[16] = .32$, $p > .05$), or kick returners ($t[16] = .41$, $p > .05$). Defensively, linemen spearing de-

Table 1. The Number of Total Plays, Ungradable Plays, All Spearing Incidents, Total Tackler Spears, Independent Tackler Spears, Ball Carrier Spears, and Concurrent Tackler Spears

	Games									
	1	2	3	4	5	6	7	8	9	Total
1990 Season										
Total Plays	102	101	111	95	121	101	107	111	96	945
Ungradable Plays	4	2	5	4	4	6	3	7	10	45
All Spearing Incidents	41	57	39	41	53	36	44	49	38	398
Total Tackler Spears	23	35	23	25	33	25	26	27	25	242
Independent Tackler Spears	13	19	11	15	19	17	14	13	16	137
Ball Carrier Spears	18	22	16	16	20	11	18	22	13	156
Concurrent Tackler Spears	10	16	12	10	14	8	12	14	9	105
1975 Season										
Total Plays	109	111	112	114	127	101	95	105	108	982
Ungradable Plays	10	5	3	2	7	4	7	1	3	42
All Spearing Incidents	30	45	60	41	41	48	48	34	42	389
Total Tackler Spears	18	30	37	29	29	32	31	23	26	255
Independent Tackler Spears	14	27	23	24	24	23	21	20	17	193
Ball Carrier Spears	12	15	23	12	12	16	17	11	16	134
Concurrent Tackler Spears	4	3	14	5	5	9	10	3	9	62

Table 2. The Number of Running Plays, Passes, Incomplete Passes, Kick Returns, Interception/Fumble Returns, and the Number of Those Plays That Included at Least One Spear (More Than One Spear Can Occur on a Play)

	1990		1975	
	No. of Plays	Plays with Spear	No. of Plays	Plays with Spear
Running plays	639	234 (37%)	712	242 (34%)
Pass plays	220	14 (6%)	142	10 (7%)
Incomplete passes	133	1 (1%)	83	0 (0%)
Kick returns	66	25 (38%)	82	25 (30%)
Interception/fumble returns	20	0 (0%)	46	8 (17%)

creased significantly during the 1990 season ($t[16] = 3.00, p < .05$). There were no differences for linebackers ($t[16] = .95, p > .05$), defensive backs ($t[16] = 1.34, p > .05$), or special team players ($t[16] = .11, p > .05$) between the two seasons.

DISCUSSION

Ball Carrier Spearing

There was no statistical difference in the incidence of ball carrier spearing between the 1975 and the 1990 seasons. The study of a 1989 season reported an incidence of 1/5.1 plays for ball carrier spearing.[13] This represents a 3% higher incidence than the 1990 season and a 6% increase over the 1975 season.

There was an increase during 1990 of spearing by running backs (Fig 1). This change may be related to a more aggressive running style. Running backs (and ball carriers in general) can approach contact in two ways: they can try to evade the tackle, or they can try to break the tackle. When the running back tries to evade a tackle (change of direction, spin, straight arm), he keeps his head out of contact in most situations. Ball carrier spearing arises most often for running backs when the player attempts to break a tackle (aggressive running). In this situation, the running back usually approached the contact with his head up. Just before contact, he began lowering his head and made contact with his helmet while his neck was going from extension to flexion. During 1975, running backs seemed to try and break a tackle when they had no other option. During the 1990 season, running backs appeared to have a more aggressive running style. It seemed they were attempting to break tackles even though they had space to maneuver away from defenders.

Running backs were responsible for the majority of the ball carrier spearing incidents for both seasons (Table 4). Kick returners accounted for 6 spears for 1975 and 9 for 1990, less than 7% of the total ball carrier spearing incidents over both seasons. However, they did spear on 9 of the 66 kick returns (14%), which is close to matching the overall incidence of ball carrier spearing.

For offensive players, the pass was the safest regarding spearing. Receivers accounted for less than 4% of the spears over both seasons (3 for 1975 and 5 for 1990). Only 24 of the 362 passing plays (7%) involved a spear. None of the incomplete passes involved a spear by a receiver. However, the ball carrier spearing distribution in this study does not completely match the incidence of catastrophic injuries between 1977 and 1992.[22] By the distribution of ball carrier spears I observed in this study, I would have expected running backs to have far more catastrophic injuries than receivers or quarterbacks.

The rule change appears to have had no association with decreasing the incidence of ball carrier spearing in this study. Prior research focusing on head and neck injuries in football emphasized tacklers and blockers.[1,4,6,7,9,15,20,21,23,28–34] The high school spearing rules do not specifically mention ball carriers at all.[24] These factors have allowed the techniques of ball carriers to be overlooked and the dangers of ball carrier spearing to go unrecognized. During the 1992 season, two ball carriers were paralyzed as a result of spearing.[22] Being tackled has always been one of the leading causes of fatalities in football.[20] Spearing by ball carriers is an extremely dangerous contact technique.[11–13] Fortunately, authors[8,10–14,22] have begun to recognize ball carriers regarding contact techniques, catastrophic injuries, and penalty enforcement.

Table 3. The Number of Spears by Defensive Backs, Linebackers, Linemen, Special Team Players, and Offensive Players Tackling on a Turnover Return

	1990	1975
Defensive backs	87 (36%)	70 (28%)
Linebackers	89 (36%)	77 (30%)
Linemen	38 (16%)	71 (28%)
Special team players	28 (12%)	28 (11%)
Offensive players on turnover	0 (0%)	7 (3%)
Total	242 (100%)	255 (100%)

Fig 1. Spearing by running backs increased during the 1990 season.

Table 4. The Number of Ball Carrier Spears by Running Backs, Quarterbacks, Receivers, Kick Returners, Defensive Players on a Turnover Return, and Offensive Linemen on Fumble Advance

	1990		1975	
Running backs	132	(85%)	101	(75%)
Quarterbacks	10	(6%)	19	(14%)
Receivers	5	(3%)	3	(2%)
Kick returners	9	(6%)	6	(5%)
Defensive players on turnover return	0	(0%)	4	(3%)
Offensive linemen on fumble advance	0	(0%)	1	(1%)
Total	156	(100%)	134	(100%)

Concurrent Tackler Spearing

During 1990, tacklers were almost 4 times more likely to spear when a ball carrier speared. During 1975, tacklers were 2 times more likely to spear when tackling a spearing ball carrier. In most situations, the tackler reacts to the ball carrier when making a tackle.[11,13] Tacklers often react to a spearing ball carrier by making contact in a similar manner (Fig 2) or attempting a tackle below the waist.[11,13] Drake[8] found that tacklers who tackle below the waist are more likely to make contact with their heads down, or in the spearing position. The results from this study agree with that conclusion. On the basis of all this information, I strongly suggest that ball carrier spearing influences the use of spearing techniques by tacklers.

The incidence of concurrent tackler spearing was 21% higher during the 1990 season than the 1975 season. This increase was statistically significant and was associated with an increase in spearing by running backs during 1990. The incidence reported during 1989 for concurrent tackler spearing[13] was almost identical to the incidence in this study for the 1975 season. The common factor in all three seasons is that tacklers were reacting in similar ways when a ball carrier speared.

Concurrent tackler spearing has caused catastrophic injuries to tacklers. Two spearing tacklers who were paralyzed in 1992 were associated with ball carriers who were spearing.[22] In the video "Prevent Paralysis: Don't Hit with Your Head,"[27] there are 19 hits that resulted in paralysis. Four of those hits (hits 7, 14, 15, 16) were concurrent tackler spears as defined in this study.

Total Tackler Spearing

The incidence of total tackler spearing was virtually identical for 1975 and 1990. There were over 26 tackler spears per game during both seasons. These numbers match up well with Drake's[8] study of 809 high school tackles where 21% of the tacklers speared. Considering that spearing presents the greatest risk to tacklers,[1,15,18–23,28–34] these numbers appear alarmingly high. The one type of spearing that did significantly decrease in 1990 was independent tackler spearing. Independent tackler spearing decreased by 5%. This was one area where the rule change appears to be associated with a significant decrease in the incidence of spearing (Fig 3).

There appeared to be general differences in the tackler's intentional and unintentional spearing techniques between the two seasons (although this data was not tabulated). In 1975, there seemed to be more tacklers hitting with their necks preflexed (intentional spear). With this type of spear, the tackler approached contact with his head lowered and already in the spearing position. It also could include the tackler who speared players who were already down (late hit). This description of spearing is consistent with Torg's[32,34] emphasis upon the axial loading mechanism being related to deliberate use of the head as a battering ram. It is also consistent with the 1976 rule change that banned deliberate use of the helmet. A different spearing technique seemed more common during the 1990 season. It appeared that more tacklers were using an unintentional spearing technique similar to ball carriers. The tackler approached contact with his head up. At the last instant, he lowered his head and initiated contact with the top of his helmet while his neck was moving from extension to flexion. This type of spearing matches the difficulties coaches have described in teaching players to play heads-up football.[21,22]

During both seasons, linebackers accounted for the most spears (Table 3). This coincides with the fact that linebackers usually lead the defense in overall tackles. Defensive backs were slightly behind linebackers for both seasons. There was no change in the incidence of spearing between the two seasons for linebackers or defensive backs. The incidence of spearing by defensive linemen, however, decreased during 1990 by 12%. The spearing rule appears to have had a favorable impact on the spearing of these players in this study. The incidence of special team spears was basically the same for both seasons.

All Spearing Incidents

The incidence of spearing did not change significantly between the two seasons (Table 5). The decrease in 1990 of independent tackler spearing was offset by the increases in running back spearing and concurrent tackler spearing. There were over 40 spears per game for both seasons.

Most spears occurred during running plays in both seasons (Table 2). Kick returns included a spear as often as running plays. During 1990, there was one spear for every 1.8 kick

Table 5. The Cumulative Incidence of All Spearing, Total Tackler Spearing, Independent Tackler Spearing, Ball Carrier Spearing, and Concurrent Tackler Spearing for Both Seasons

	1990	1975
All spearing	1/2.4 plays	1/2.5 plays
Total tackler spearing	1/3.9 plays	1/3.8 plays
Independent tackler spearing	1/5.7 plays	1/4.4 plays
Ball carrier spearing	1/6.1 plays	1/7.3 plays
Concurrent tackler spearing	1/1.5 ball carrier spearing	1/2.2 ball carrier spearing

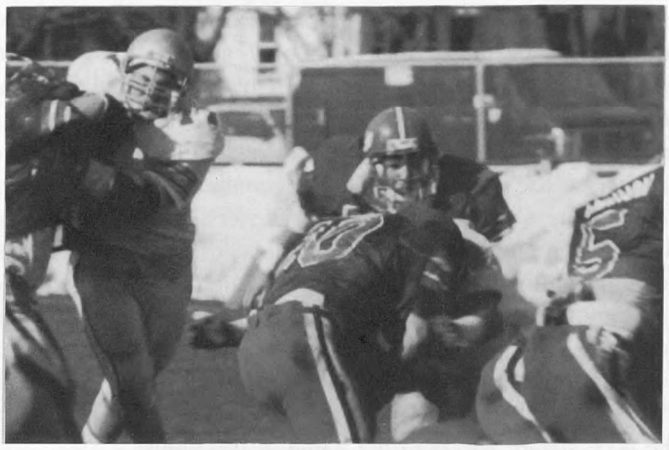

Fig 2. Tacklers were more likely to spear when a ball carrier speared (concurrent tackler spearing).

Fig 3. Independent tackler spearing decreased during 1990.

returns. This incidence was the highest observed in this study. Special teams' players have been one of the leading positional players associated with catastrophic injuries.[22,34] This is probably the most dangerous play in football considering that kicking plays account for only approximately 7% of the total plays involving a ball carrier per game.

In 1990, 13,900 high schools offered varsity football in the United States (phone communication with the National Federation of State High Schools Association, November 1995). In this study, during 1990, a team averaged 199 spears per season. If these schools are representative of other high schools, then, nationally there are approximately 2,766,100 spears associated with contact between tacklers and ball carriers during a 9-game season. During 1990, there were 11 catastrophic injuries to high school players. If all of these injuries were associated with varsity players tackling or being tackled, there was approximately one catastrophic injury for every 251,464 spears.

Further Research

This study raises a few important questions. Why has the number of injuries resulting in paralysis dramatically decreased since the rule change if the incidence of spearing has not changed? It is important to note that the number of cervical spine fractures/dislocations occurring without quadriplegia have not been reduced as significantly.[2,21,28] Spinal cord injury is secondary to vertebra damage and each incident of fracture/dislocation has the potential for paralysis. Therefore, the reduction in the incidents of quadriplegia may also be due to improvements in surgical techniques[32,33] and better on-the-field management of these injuries.[2,21–23]

An area for future research is to explore whether a change in tacklers' spearing biomechanics may be responsible for the reduction in catastrophic injuries. Has there actually been a change from intentional spearing (approaching contact with the neck preflexed) to unintentional spearing (dropping the head from extension at the last instant)? After viewing these films, I believe this explanation holds merit, although this opinion cannot be substantiated by the data collected in this study. Biomechanics may also explain why there have been so many more catastrophic injuries to tacklers than to ball carriers. The constant for catastrophic injuries to ball carriers is that they have been consistently low even before the rule change.[30,34] It appeared that ball carriers consistently dropped their heads at the last instant when spearing, during both seasons in this study. Further study is also needed examining whether ball carriers' spearing biomechanics have been consistent before and after the rule change.

The possibility exists that it is more difficult to place an axial load on the cervical spine when the neck is in transition from extension to flexion. The experimental research that has reproduced the axial loading mechanism with both cadavers and models have placed energy loads on the cervical spine when the neck is already fixed in flexion.[3,5,17,25,37,38] Even the studies examining the cervical spine under unfixed conditions place the neck in the spearing position before impact forces are placed on the cervical spine. An area for future research may be to explore the difficulty in reproducing an axial load while the neck is in motion from extension to flexion.

The other question is, "Why have defensive backs received the majority of catastrophic injuries if linebackers have speared as frequently?" Defensively, secondary players have received the most catastrophic injuries followed by linebackers and then linemen.[21–23,28–34] This order also follows the distance of each position from the line of scrimmage. That is, defensive backs start 8 to 10 yards off the ball, linebackers begin 3 to 5 yards off the ball and linemen are on the line of scrimmage. Therefore defensive backs potentially generate the most momentum before they make contact. Linemen have the least distance between them and the ball carrier.

This may suggest that a higher incidence of injury to defensive backs is related to spearing and the amount of momentum at contact. Special teams' players have accounted for the second largest number of catastrophic injuries behind defensive backs. Considering that there are only about 5 to 10 kick returns per game, it is obvious that they do not have nearly the opportunity to spear as other defensive players. However, they do start 40 to 60 yards away from the kick returner and have the greatest opportunity to generate momentum before a spear.

It is well established that little force is needed to cause failure of the cervical spine when it is precisely aligned in a segmented column.[15] A running football player can possess

1500 ft-lb of kinetic energy, whereas, in the laboratory, cervical injury has been reproduced with as little as 150 ft-lb of kinetic energy.[15] But, on the field (in vivo), do higher forces at impact compensate for less than precise positioning of the neck? This is another area that requires further study.

Reducing the Incidence of Spearing

Each time a player initiates contact with his head, he increases the risk of concussion.[4,7,8,26] Each time a player initiates contact with the crown of his helmet, he risks quadriplegia.[2,6,9,15,20–23,28–36] The spearing incidence observed in this study demonstrates there is still significant room for improvement in eliminating spearing. A concerted effort by coaches, officials, the medical community, and re-examining the spearing rules can further reduce the incidence of spearing and also decrease the risk of head and neck injuries in football.

Initiating contact with the shoulder while keeping the head up is the safest contact position for all players.[11–16,20–23] Leidholt[16] has emphasized that teaching correct technique will do far more to prevent injuries than exercises. Coaches have expressed that they have taught players to tackle correctly, but the players still have a tendency to lower their heads just before contact.[21,22] This technique of unintentional spearing was observed in this study. I believe this is an obvious indicator that coaches must spend additional time practicing correct technique with ball carriers, tacklers, and blockers.

It seems that players have learned to approach contact with the head up. However, players have a fear of contact[3] or the instinct to protect their eyes and face from injury by lowering their heads at impact.[11,13] It appears the level of instruction has not overcome this fear. Practice and contact drills that focus on keeping the head up while initiating contact with the shoulder must overcome this protective instinct (Fig 4). Athletic trainers and other medical professionals must continually emphasize these concepts to coaches. Torg[30] indicated that it is not enough to avoid teaching head-first contact. It is my contention that a player who receives no instruction will spear with the neck in the preflexed position. A player who receives insufficient practice time with correct technique will spear unintentionally by lowering his head at the crucial instant of impact.

Fig 4. Players need additional practice time to improve the technique of keeping their heads up at contact.

The spearing rules and football officials' interpretation and enforcement of these rules also play an important role in reducing the incidence of spearing. In my opinion, the practical definition of spearing has changed and I believe this has outdated the current rules. The major restriction is that the rule limits itself to "intentional"[24] helmet contact. The current rules do not address unintentional or ball carrier spearing.[10] A recent survey of high school officials indicated that they felt that deciding on intent made the spearing rule difficult to enforce and they were least likely to call a spearing penalty on a ball carrier.[10] This survey also revealed that officials called an estimated 1 spearing penalty for every 20 games they worked. This enforcement rate appears drastically out of proportion to the 40+ spears observed per game in this study.

Rule changes that address unintentional head-down contact and ball carriers may further reduce the risk of serious head and neck injuries. It may also further reduce the consistent incidence of 4 to 10 catastrophic spine injuries that have occurred annually since 1980. However, the ultimate effectiveness of any rule is heavily dependent upon officials appropriately enforcing these rules during football games.[10]

CONCLUSION

In this study, it does not appear that the spearing rule had a favorable impact upon decreasing the overall incidence of spearing. In fact, the incidence of running back spearing and concurrent tackler spearing actually increased during the 1990 season. However, there were decreases during 1990 of independent tackler spearing and spearing by defensive linemen. One major limitation of this study is that it only looked at two different seasons of one school. Further research needs to be done including other high schools from different geographical areas. Other seasons, both before and after the spearing rule change, also need to be studied.

ACKNOWLEDGMENTS

I once again thank the Millville Football Program for their courtesy and the prolonged use of their equipment. I also thank Steve Glasgow, MD, for his enthusiasm in helping me realize the potential of this project when it was in its infantile stages.

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. Anderson C. Neck injuries: backboard, bench, or return to play. *Phys Sportsmed.* Aug 1993;21:23–34.
3. Bishop PJ. Impact postures and neck loading in head first collisions: a review. In: Hoerner EF, ed. *Head and Neck Injuries in Sports ASTM STP 1229.* Philadelphia, PA: American Society for Testing and Materials; 1994:127–141.
4. Buckley WE. Concussions in college football. *Am J Sports Med.* 1988; 16:51–56.
5. Burstein AH, Otis JC. The response of the cervical spine to axial loading: feasibility for intervention. In: Hoerner EF, ed. *Head and Neck Injuries in Sports ASTM STP 1229.* Philadelphia, PA: American Society for Testing and Materials;1994:142–153.

6. Cantu RC. Head and spine injuries in the young athlete. *Clin Sports Med.* 1988;7:459–472.
7. Cantu RC. Guidelines for return to contact sports after a cerebral concussion. *Phys Sportsmed.* Oct 1986;14:75–83.
8. Drake GA. Research provides more suggestions to reduce serious football injuries. *Natl Fed News.* Nov/Dec 1994;18–21.
9. Football-related spinal cord injuries among high school players—Louisiana, 1989. *MMWR.* 1990;39:586–587.
10. Heck JF. A survey of New Jersey high school football officials regarding spearing rules. *J Athl Train.* 1994;30:63–68.
11. Heck JF. The incidence of spearing by ball carriers and their tacklers during a high school football season. In: Hoerner EF, ed. *Head and Neck Injuries in Sports ASTM STP 1229.* Philadelphia, PA: American Society for Testing and Materials; 1994:239–248.
12. Heck JF. An analysis of football's spearing rules. *Sideliner, J Athl Train Soc NJ.* 1993;9:8,9,15.
13. Heck JF. The incidence of spearing by high school football ball carriers and their tacklers. *J Athl Train.* 1992;27:120–124.
14. Heck JF, Weis MP, Gartland JM, Weis CR. Minimizing liability risks of head and neck injuries in football. *J Athl Train.* 1994;29:128–139.
15. Hodgson VR, Thomas LM. Play head-up football. *Natl Fed News.* 1985;2:24–27.
16. Leidholt JD. Spinal injuries in athletes: be prepared. *Orthop Clin North Am.* 1973;4:691–698.
17. Maiman DJ, Sances A Jr, Myklebust JB, et al. Compression injuries of the cervical spine: a biomechanical analysis. *Neurosurgery.* 1983;13:254–260.
18. Marzo JM, Simmons EH, Whieldon TJ. Neck injuries to high school football players in Western New York State. *NY State J Med.* 1991;91: 46–49.
19. McKeag DB, Cantu RC. Neck pain in a football player. *Phys Sportsmed* Mar 1990;18:115–120.
20. 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.
21. Mueller FO, Blyth CS, Cantu RC. Catastrophic spine injuries in football. *Phys Sportsmed* Oct 1989;17:51–53.
22. Mueller FO, Cantu RC. Annual survey of catastrophic football injuries: 1977–1992. In: Hoerner EF, ed. *Head and Neck Injuries in Sports ASTM STP 1229.* Philadelphia, PA: American Society for Testing and Materials; 1994:20–27.
23. Mueller FO, Cantu RC. The annual survey of catastrophic football injuries: 1977–1988. *Exerc Sport Sci Rev.* 1991;19:261–268.
24. National Federation of State High School Associations. *Official Football Rules.* Kansas City, MO: NFSHSA; 1992:15,22,50.
25. Pintar FA, Yoganandan N, Sances A Jr, Cusick JF. Experimental production of head-neck injuries under dynamic forces. In: Hoerner EF, ed. *Head and Neck Injuries in Sports ASTM STP 1229.* Philadelphia, PA: American Society for Testing and Materials; 1994:203–211.
26. Saal JA, Sontag MJ. Head injuries in contact sports: sideline decision making. *Phys Med Rehabil.* 1987;1:649–657.
27. Torg JS. *Prevent Paralysis: Don't Hit With Your Head.* [Videotape]. Philadelphia, PA: Penn Sports Medicine; 1992.
28. Torg JS. Epidemiology, pathomechanics, prevention of football-induced cervical spinal cord trauma. *Exerc Sports Sci Rev.* 1992;20:321–338.
29. Torg JS. The epidemiologic, biomechanical, and cinematographic analysis of football induced cervical spine trauma. *Athl Train, JNATA.* 1990;25: 147–159.
30. Torg JS. Epidemiology, pathomechanics, prevention of athletic injuries to the cervical spine. *Med Sci Sports Exerc.* 1985;17:295–303.
31. 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.
32. Torg JS, Sennett B, Vegso JJ. Spinal injury at the third and fourth cervical vertebrae resulting from the axial loading mechanism: an analysis and classification. *Clin Sports Med.* 1987;6:159–185.
33. Torg JS, Sennett B, Vegso JJ, Pavlov H. Axial loading injuries to the middle cervical spine segment. *Am J Sports Med.* 1991;19:6–20.
34. 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.
35. Watkins RG. Neck injuries in football players. *Clin Sports Med.* 1986;5: 215–247.
36. Wilberger JE, Maroon JC. Cervical spine injuries in athletes. *Phys Sportsmed.* Mar 1990;18:57–70.
37. Yoganandan N, Pintar FA, Sances A Jr, Reinartz J, Larson SJ. Strength and kinematic response of dynamic cervical spine injuries. *Spine.* 1991; 16:S511-S517.
38. Yoganandan N, Sances A Jr, Maiman DJ, Myklebust JB, Pech P, Larson SJ. Experimental spinal injuries with vertical impact. *Spine.* 1986;11:855–859.

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Academic Preparation of Athletic Trainers as Counselors

Sharon P. Misasi, MS, ATC; Charles F. Davis, Jr, MEd, ATC; Gary E. Morin, MS, ATC; Donnaleigh Stockman, BS

ABSTRACT: Athletic trainers have assumed several roles and responsibilities over the years, but perhaps there is no more important role than that of a counselor. Are they prepared to do so? One hundred and thirty-two modified Revised Wylie Inventories were mailed to college/university athletic trainers to examine their educational preparation and experiences with counseling in various areas. Most athletic trainers surveyed reported that they were predominantly counseling in the areas of injury prevention, injury rehabilitation, and nutrition, and felt academically prepared to do so. However, it was reported that preparation to counsel in other less common areas (eg, family matters, financial matters, etc) was not adequately addressed in academic programs. The athletic trainers surveyed sought continuing education in order to meet the other counseling needs of student-athletes. Although they used several psychological referral services, it was apparent that most athletic trainers frequently served as counselors on many nonorthopedic topics. We suggest that athletic training educators consider incorporating both academic knowledge and clinical experience in a wider variety of counseling areas into their curricula.

Athletic trainers have many roles and responsibilities which are described by the NATA in the five professional domains. In addition to the more obvious responsibilities, such as injury prevention, recognition, evaluation, treatment, and rehabilitation, athletic trainers must be concerned with organizational and administrative tasks as well as serve as educators and counselors on these and other topics.

Several articles have been published concerning the role of athletic trainers as counselors.[1–10,12] Athletic trainers typically maintain unique relationships with student-athletes in that they work closely with the student-athletes from the time they become injured to the day they return to participation. Athletic trainers are often privileged participants in many conflicts that student-athletes experience.[2–9] In this study, we examined the counseling practices, educational background, and referral sources of athletic trainers at the college/university level.

METHODS

Every seventh (a randomly chosen number) college or university listed in the *1993–1994 National Directory of College Athletics* (Gray Printing Co) was selected to receive a survey, provided the name of the institution's athletic trainer was included in the listing. If the institution's athletic trainer was not listed, the next college or university in line was chosen. We mailed 132 surveys along with a cover letter explaining the basic procedures of the study and a self-addressed, stamped envelope.

The survey instrument was a modified version of the Revised Wylie Inventory.[3,11] One side of the instrument was used to gather demographic data and background information on the responding athletic trainers and their institutions. Subjects were asked to indicate the athletic level of their institutions, their educational route to certification, their highest degree earned, and their title/position. In addition, they were asked to indicate any counseling or psychology courses they had participated in and where their student-athletes were referred for additional assistance (Table 1).

On the other side of the survey, subjects were asked to rank order the following 11 counseling areas from the most to the least counseled according to their past experience: alcohol-related problems, nutrition, drug use/abuse, injury prevention, injury rehabilitation, relationship issues, sexual issues, suicide, family matters, racial issues, and financial issues. They were also asked if they felt their academic and clinical programs prepared them to counsel in these 11 areas and if more emphasis should have been placed on these areas in their athletic training education. They were then asked in what setting the emphasis should have been placed, ie, course work, clinical setting, or both settings equally, and whether they had participated in any course work, seminars, or workshops addressing any of these 11 areas. Finally, subjects were asked if, given the opportunity, they would participate in the same.

RESULTS

Of the 132 surveys mailed, 90 (68%) were returned. Of those returned, 23 (29%) represented Division I, 32 (36%) were from Division II, 25 (28%) were from Division III, and 9 (11%) were returned from NAIA colleges or universities. Additional subject data is presented in Table 1.

Most subjects surveyed had matriculated through an introductory psychology course, and more than half had enrolled in a sports psychology and/or developmental psychology course. Abnormal psychology and adolescent psychology courses had

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Table 1. Demographics and Referral Sources

	No.	(%)
Athletic level of institution:		
Division I	23	29
Division II	32	36
Division III	25	28
NAIA	9	11
Route to certification:		
NATA curriculum program	42	43
Internship program	47	54
Highest degree earned:		
Bachelor's	8	9
Master's	69	81
Doctorate	6	7
Other degree	2	2
Title/Position:		
Head Athletic Trainer	47	54
Head Athletic Trainer/Instructor	32	37
Assistant Athletic Trainer	1	1
Assistant Athletic Trainer/Instructor	2	2
Program Director	11	12
Program Director/Instructor	1	1
Courses taken:		
Introduction to Psychology	82	93
Group Dynamics	7	9
Sports Psychology	52	59
Introduction to Counseling	20	23
Group Facilitation	4	4
Abnormal Psychology	40	46
Adolescent Psychology	34	41
Developmental Psychology	44	52
Multicultural Psychology	1	1

Where do you refer student-athletes for assistance?
Please rank: 1—Always; 2—Often; 3—Sometimes; 4—Rarely

	1	(%)	2	(%)	3	(%)	4	(%)
Sport Psychologist	1	(1)	3	(3)	17	(19)	45	(52)
Counselors on Campus	23	(27)	27	(31)	18	(21)	7	(8)
Health Center	9	(10)	40	(48)	21	(23)	9	(10)
Outside Agency	1	(1)	4	(6)	22	(24)	42	(48)

been taken by less than half of the subjects. A smaller percentage of the athletic trainers surveyed had enrolled in the remaining courses (Table 1).

When asked where student-athletes were referred for additional assistance, 23 (27%) responded "always" to a counselor on campus, 40 (48%) responded "often" to the Health Center, and 27 (31%) responded "often" to a counselor on campus. The response of "sometimes" was applied to many areas: outside agency (22 (24%)); health center (21 (23%)); counselor on campus (18 (21%)); and sports psychologist (17 (19%)). Those services "rarely" considered by those surveyed included referral to a sports psychologist (45 (52%)) and an outside agency (42 (48%); Table 1).

Tables 2 through 8 summarize the data regarding the 11 counseling areas. Table 2 indicates the ranking of counseling areas from most to least counseled. Injury rehabilitation and injury prevention were ranked 1 and 2, respectively, followed by nutrition, alcohol problems, and drug use/abuse. The least counseled areas included family matters, financial issues, and suicide, in order.

Table 2. Rank Order From Most to Least Counseled Areas According to Past Experience

1. Injury rehabilitation	7. Relationship issues
2. Injury prevention	8. Racial issues
3. Nutrition	9. Family matters
4. Alcohol problems	10. Financial issues
5. Drug use/abuse	11. Suicide
6. Sexual issues	

Table 3 represents the subjects' responses regarding their academic preparation for counseling in these areas. The injury rehabilitation and injury prevention areas received strong affirmation, as did nutrition and drug use/abuse. The subjects did not feel that their educational programs prepared them well enough to address racial issues, suicide, financial issues, family matters, relationship issues, sexual issues, and alcohol problems.

Table 4 demonstrates that the subjects' clinical programs prepared them to counsel in the areas of injury prevention, injury rehabilitation, and nutrition. However, the subjects did not feel that their clinical education prepared them to counsel in the remaining areas.

Table 5 shows that the majority of the subjects believe that more emphasis should be placed on all of the counseling areas in academic education. Table 6 indicates that the exposure should come from neither course work nor the clinical setting alone, but from both equally.

Table 7 reflects that the majority of those surveyed had participated in additional course work, seminars, and workshops since their initial training, especially in the areas of injury prevention, injury rehabilitation, drug use/abuse, nutrition, and alcohol problems. Again, the majority of those surveyed indicated that they had received very little additional training in the following areas: relationship issues, sexual issues, suicide, family matters, racial issues, and financial issues. Table 8 indicates that the subjects would participate in additional course work, seminars, and workshops that addressed all of the areas studied.

DISCUSSION

The top three areas counseled (Table 2) concurred with the same areas in which subjects felt their academic programs had adequately prepared them to counsel (Table 3). These same top

Table 3. Do You Feel Your Academic Program Prepared You to Counsel in These Areas?

	Yes	(%)	No	(%)
Alcohol	40	(44)	50	(56)
Nutrition	70	(78)	18	(20)
Drug use/abuse	45	(50)	7	(8)
Injury prevention	85	(94)	3	(3)
Injury rehabilitation	84	(93)	4	(4)
Relationship issues	21	(23)	69	(77)
Sexual issues	26	(29)	59	(66)
Suicide	5	(6)	80	(89)
Family matters	8	(9)	70	(78)
Racial issues	6	(7)	81	(90)
Financial issues	8	(9)	79	(88)

Table 4. Do You Feel Your Clinical Program Prepared You to Counsel in These Areas?

	Yes	(%)	No	(%)
Alcohol	32	(36)	50	(56)
Nutrition	56	(62)	32	(36)
Drug use/abuse	37	(41)	45	(50)
Injury prevention	77	(86)	6	(7)
Injury rehabilitation	75	(83)	8	(9)
Relationship issues	19	(21)	62	(69)
Sexual issues	21	(23)	60	(67)
Suicide	7	(8)	75	(83)
Family matters	16	(18)	65	(72)
Racial issues	17	(19)	64	(71)
Financial issues	14	(16)	66	(73)

Table 5. Do You Feel That More Emphasis Should Be Placed on These Areas in Academic Education?

	Yes	(%)	No	(%)
Alcohol	79	(88)	8	(9)
Nutrition	75	(83)	11	(12)
Drug use/abuse	83	(92)	6	(7)
Injury prevention	72	(80)	14	(16)
Injury rehabilitation	72	(80)	14	(16)
Relationship issues	52	(57)	7	(8)
Sexual issues	66	(73)	21	(23)
Suicide	60	(67)	27	(30)
Family matters	52	(58)	32	(36)
Racial issues	61	(68)	25	(28)
Financial issues	48	(53)	38	(42)

Table 6. Should This Emphasis Come in Course Work, Clinical Setting, or Both Equally

	Course Work		Clinical Setting		Both Equally	
	No.	(%)	No.	(%)	No.	(%)
Alcohol	25	(28)	5	(6)	55	(61)
Nutrition	23	(26)	3	(3)	63	(70)
Drug use/abuse	18	(20)	4	(4)	62	(69)
Injury prevention	12	(13)	4	(4)	65	(72)
Injury rehabilitation	11	(12)	7	(8)	64	(71)
Relationship issues	26	(29)	7	(8)	40	(44)
Sexual issues	30	(33)	5	(7)	40	(44)
Suicide	29	(32)	6	(7)	44	(49)
Family matters	23	(26)	6	(7)	50	(55)
Racial issues	24	(27)	4	(40)	48	(53)
Financial issues	33	(37)	2	(2)	35	(39)

three areas matched the results of a study completed by Furney and Patton,[3] in which it was found that high school athletic trainers felt qualified to counsel in the areas of injury prevention, injury rehabilitation, and nutritional concerns.

Issues related to alcohol and drug use/abuse were ranked 4th and 5th, respectively. Subjects responded that they did not feel that their academic programs prepared them to counsel in these areas. In a survey of varsity athletes at a Division I university, Schneider and Morris[7] reported that 12% of the respondents were at least occasionally using banned substances, and that 57% had at least some experience with illicit drugs. Based on this, it can be expected that the athletic trainer would be involved at some level in counseling athletes with alcohol and drug-related problems. Unfortunately, there is no specific course required of student athletic trainers addressing the issue of alcohol/drug abuse or any of the other areas surveyed. These problems are touched upon in other classes such as health and psychology, but, based upon the results of the survey, it does not seem to be effective. Since their initial education, a large percentage of respondents have sought continuing education in the form of seminars or workshops on counseling alcohol drug abuse, and other problems.

Table 7. Have You Participated in Any Course Work, Seminars, Workshops in the Areas Listed Since Initial Training?

	Yes	(%)	No	(%)
Alcohol	62	(69)	25	(28)
Nutrition	67	(74)	19	(21)
Drug use/abuse	68	(76)	18	(20)
Injury prevention	83	(92)	4	(4)
Injury rehabilitation	83	(92)	5	(6)
Relationship issues	28	(31)	57	(63)
Sexual issues	42	(47)	43	(48)
Suicide	16	(18)	70	(78)
Family matters	21	(23)	61	(68)
Racial issues	24	(27)	57	(63)
Financial issues	19	(21)	61	(68)

Table 8. Would You Participate in Workshops, Seminars, or Classes in These Areas?

	Yes	(%)	No	(%)
Alcohol	77	(86)	10	(11)
Nutrition	82	(91)	6	(7)
Drug use/abuse	81	(90)	8	(9)
Injury prevention	85	(94)	1	(1)
Injury rehabilitation	82	(91)	4	(4)
Relationship issues	57	(63)	28	(31)
Sexual issues	68	(76)	17	(19)
Suicide	58	(64)	28	(31)
Family matters	56	(62)	30	(33)
Racial issues	57	(63)	29	(32)
Financial issues	54	(60)	31	(34)

In addition to their academic programs, the athletic trainers surveyed affirmed that their clinical education was helpful in preparing them to counsel in the areas of injury rehabilitation, injury prevention, and nutrition. However, their clinical education did not seem to prepare the subjects to counsel in the remaining areas. Perhaps student athletic trainers need to be included in discussions with the athlete so as to develop necessary counseling skills.

One interesting problem encountered in the study was the interpretation of the term "clinical setting." Some of the responding athletic trainers considered "clinical setting" to indicate work performed in a physical therapy/sports medicine clinic rather that the "on-the-job training" student athletic trainers receive as part of their overall academic education. It appears that there was confusion between clinical hours and clinical practice. Perhaps specifying "hands-on learning in an academic setting" would have been more beneficial and descriptive, and should be considered in future studies.

The instructions given to subjects before each question on the questionnaire were implicated as another problem with the

study. Some of the subjects either did not answer all of the questions or responded more than once to a specific question on the survey instrument. For example, regarding the title/position (Table 1), some subjects selected all choices that applied, which resulted in a percentage total greater than 100%. In the future, the Modified Revised Wylie Inventory needs to include more specific instructions that will facilitate a single response to all questions on the instrument.

Due to their daily availability to their athletes and their roles as health care providers, athletic trainers often assume the role of "father/mother/confessor." As the data indicate, the respondents' scope of counseling goes beyond that of orthopedic care into areas not traditionally applied to athletic trainers. Entry-level student athletic trainers are required to complete course work in injury prevention, management, rehabilitation, and nutrition, but, unfortunately, only an introduction to psychology course is required before sitting for the NATA-BOC examination. Although 34 respondents (just over 40%) had completed an adolescent psychology course, a much smaller percentage had enrolled in course work pertaining to counseling. It may be appropriate, therefore, that future revisions of required academic course work include a counseling course and/or courses related to the various areas addressed in this survey.

Most subjects who ranked the top five counseling areas also participated in additional educational sessions addressing the same five areas. The general opinion was that they would continue to seek additional education and experience in order to increase their abilities to counsel in these areas. Thus, it may be prudent to include counseling topics in future athletic training workshops and conferences. Certified athletic trainers can use these experiences as continuing education units which are imperative to maintaining good status within the NATA-BOC.

CONCLUSION

As athletic trainers establish relationships with their athletes that are mostly based on trust, their opinions are often sought by athletes regarding topics other than injury prevention, injury rehabilitation, and nutrition. Although counseling is part of the fifth domain of the NATA Roles and Responsibilities, athletic trainers do not always have the time and/or experience to deal with the numerous psychological problems which occur on a daily basis. Referral to more qualified professionals is how counseling problems are usually handled in the training room setting. However, athletic trainers should have a basic understanding of counseling techniques, especially since student-athletes often confide in them on a multitude of nonorthopedic and personal topics.

Athletic trainers must recognize their professional and ethical limitations in caring for athletes; they cannot be all things to all people. Athletic trainers should also recognize that they are neither prepared nor equipped to deal with all of the various concerns that student-athletes may possibly present. What is important is to seek out and welcome any and all resources that can assist them in the overall care of the student-athlete.[2] However, educators of student athletic trainers should recognize counseling as an important aspect of the athletic training profession. Therefore, changes in curricula should include the appropriate academic and clinical preparation in this area. Finally, certified athletic trainers should continue to participate in course work, seminars, and workshops that address counseling situations that occur in the athletic training setting.

REFERENCES

1. Anderson MB, Alden MF. Incorporating sport psychology services into collegiate athletics. *Athl Admin*. 1991;6:23–25.
2. Compton R, Ferrante AP. The athletic trainers—helping professional partnership: an essential element for enhanced support programming for student athletes. In: Etzel EF, Ferrante AP, Pinkney JW, eds. *Counseling College Student-Athletes: Issues and Interventions*. Morgantown, WV: Fitness Information Technology; 1991;221–230.
3. Furney SR, Patton BP. An examination of health counseling practices of athletic trainers. *Athl Train, JNATA*. 1985;20:294–297.
4. Kane B. Trainer counseling to avoid three face-saving maneuvers. *Athl Train, JNATA*. 1984;19:171–174.
5. Kane B. Trainer in a counseling role. *Athl Train, JNATA*. 1982;17:167–168.
6. Pedersen P. The grief response and injury: a special challenge for athletes and athletic trainers. *Athl Train, JNATA*. 1986;21:312–314.
7. Schneider D, Morris J. College athletes and drug testing: attitudes and behaviors by gender and sport. *Athl Train, JNATA*. 1993;28:146–148, 150.
8. Singer RN, Johnson PJ. Strategies to cope with pain associated with sports-related injuries. *Athl Train, JNATA*. 1987;22:100–105.
9. Tuffy S. The role of athletic trainers in facilitating psychological recovery from athletic injury. *Athl Train, JNATA*. 1991;26:346–354.
10. Tunick R, Etzel E, Leard J. Counseling injured and disabled student-athletes: a guide for understanding and intervention. In: Etzel E, Ferrante AP, Pinkney JW, eds. *Counseling College Student-Athletes: Issues and Interventions*. Morgantown, WV: Fitness Information Technology; 1991: 176–199.
11. Wylie WE. *Needed Health Counseling Competencies of Ministers*. Knoxville, TN: University of Tennessee; 1981. Dissertation.
12. Zeske M. ATCs—counselors in sports medicine. *NATA News*. 1994;6: 4–5.

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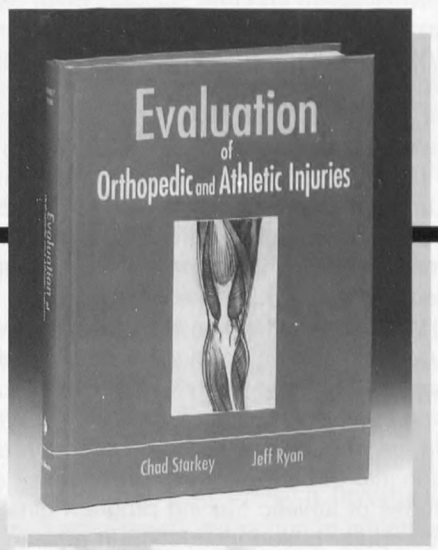

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Use of Computer-Based Instruction in Athletic Training Education

A. Louise Fincher, EdD, ATC; Kenneth E. Wright, DA, ATC

ABSTRACT: Computer-based instruction is being widely used in the education programs of many allied health professions. However, there has been little, if any, documentation of computer-based instruction use in athletic training education. The primary purpose of this study was to determine what percentage of undergraduate and graduate NATA-approved athletic training education programs are using some form of computer-based instruction (ie, computer-assisted instruction or interactive video). We also addressed the following research questions: 1) What athletic training educational software is currently being used by athletic training students and educators? 2) What factors currently impede the use of computer-based instruction in athletic training education? 3) What instructional methods are commonly used to incorporate computer-based instruction into the athletic training curricula? and 4) What are the attitudes of athletic training program directors toward the use of computer-based instruction in athletic training education? Surveys were mailed to the program directors (n = 97) of all graduate and undergraduate NATA-approved athletic training education programs. Eighty-six (87.7%) usable surveys were returned. Forty-eight (55.8%) of the respondents reported using some form of computer-based instruction in their athletic training education program; 47 (54.7%) used computer-assisted instruction and 9 (10.6%) used interactive video. Respondents also identified the educational software they use and their method for implementing this software. Software was used most often to supplement traditional instructional methods. A lack of funds was reported to be the primary impeding factor for those programs not using computer-based instruction. Respondents reported an overall positive attitude toward computer-based instruction use in athletic training education and indicated the need for increased development of athletic training/sports medicine software.

Computers are becoming widely used by educators and students from many academic disciplines to enhance the teaching and learning experience. This use of educational technology has been referred to in the literature by a variety of names including computer-based instruction,[8,22] computer-assisted instruction,[1,3,5,10,16,17,19,20,23,24,30,32,33] and interactive video instruction.[7,11,15,21,25,28] Generally, computer-based instruction has been defined to include any form of instruction that uses the computer to present instructional information, with computer-assisted instruction and interactive video being two distinct forms of computer-based instruction. Both computer-assisted instruction and interactive video present individualized instructional material and require some degree of interactivity from the learner. These forms of computer-based instruction, however, differ in their instructional features. Computer-assisted instruction programs usually incorporate the use of computer-generated graphics and text. Interactive video programs, on the other hand, use the graphics and text features of computer-assisted instruction while also adding the features of sound, realistic photo images, and full-motion video. Because of the variety of media used to develop interactive video programs, these instructional programs are also referred to as "multimedia" programs. Most interactive video or multimedia programs will also incorporate the use of a laser videodisc or a compact disc read-only memory (CD-ROM) disc.

The literature supports a widespread use of computer-based instruction in the education programs of many allied health professions.[8] In 1988, Hebda[16] surveyed baccalaureate nursing programs and found that almost half of these schools used some form of computer-assisted instruction. Similarly, a national survey of nursing programs conducted in 1989 by the Southern Regional Education Board[5] demonstrated that 91% of the 393 responding deans and directors reported using computers to teach undergraduate nursing. Although the nursing profession seems to have been the most active in authoring and studying computer-based instruction, other health professions have also reported using some form of computer-based instruction in their educational programs.[10,15,24,27,29,33] In 1987, Freeman[13] surveyed 60 allied health education programs and found that 43% of them used some form of computer-assisted instruction.

Although athletic training educators are beginning to use computer-based instruction,[4,6,9,12,14,18,31,32,34] there has been no documentation of the actual percentage of athletic training education programs using this technology. Therefore, the primary purpose of this study was to determine the percentage of undergraduate and graduate NATA-approved athletic training education programs using computer-based instruction. In keeping with the literature, we defined computer-based instruction to include the use of either computer-assisted instruction or interactive video. Additionally, we addressed the following research questions:

1. What athletic training educational software is currently being used by athletic training students and educators?
2. What factors currently impede the use of computer-based instruction in athletic training education?
3. What instructional methods are commonly used to incorporate computer-based instruction into the athletic training curricula?

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4. What are the attitudes of athletic training program directors toward the use of computer-based instruction in athletic training education?

METHODS

After reviewing the literature concerning the use of computer-based instruction in allied health professions education, we developed a survey instrument to specifically address the use of this technology in athletic training education. The 26-item survey included both closed- and open-ended questions and was divided into four major content areas: 1) status of computer-based instruction use, 2) software and instructional methods used, 3) attitudes toward computer-based instruction, and 4) demographics relative to employed position and personal computer use. A team of five athletic training educators, all of whom had their doctorate degree and experience in the design and/or use of computer-based instruction programs, reviewed the survey instrument for content validity. The refinements or suggestions made by this team were included in the final draft of the survey instrument.

The program directors (n = 96) of all NATA-approved athletic training education programs were surveyed regarding their program's use of computer-assisted instruction or interactive video. At the time of this study, there were actually 97 athletic training education programs (84 undergraduate and 13 graduate programs) approved by the NATA Professional Education Committee (NATA-PEC); however, there were only 96 program directors.[26] One program director supervised both an undergraduate and a graduate education program and was therefore asked to complete two surveys: one for his undergraduate program and one for his graduate program. Therefore, a total of 97 surveys were mailed. Since the subjects surveyed represented the entire population of NATA-approved athletic training education program directors, a sampling plan was not necessary.

All program directors were mailed a packet containing a cover letter which explained the purpose and significance of the study, a color-coded survey instrument (blue = undergraduate; green = graduate), and a pre-addressed business reply envelope. The program directors were instructed that their returned survey would serve as their informed consent form. Respondents were also given the opportunity to request a copy of the survey results. Approximately 3 weeks after the initial mailing, we sent a second mailing of surveys to insure an adequate response rate. All tabulations and statistical computations were performed using the SAS Statistical Software Package.[29]

RESULTS

Status of Computer-Based Instruction Use

A total of 89 surveys (91.8%) were returned; however, 3 of these were either completed improperly or returned incomplete. Therefore, only 86 surveys (88.7%) were included in the data analysis. Respondents included 76 undergraduate program directors and 10 graduate program directors. Forty-eight of the respondents (55.8%) reported using some form of computer-based instruction in their athletic training education program. Forty-seven respondents (54.7%) used computer-assisted instruction, while 9 (10.6%) used interactive video. When the use of computer-based instruction was analyzed by academic level, 46 (60.5%) of the undergraduate program directors used some form of computer-based instruction, while only 1 (10.0%) of the graduate program directors used this technology. The relative newness of this technology to athletic training education is illustrated by the fact that only 8 (16.7%) of the programs reported using computer-based instruction longer than 5 years (Table 1).

In an attempt to determine what factors currently impede the use of computer-based instruction in athletic training education, we asked those respondents (n = 38) who do not use computer-based instruction to select, from a provided list, the one factor which best described their reason for not using this technology. A lack of funds [24 (63.2%)] was the most common factor cited while other reasons included "I have never thought of using computer-based instruction" [9 (23.7%)], and "there is a lack of research investigating the effectiveness of computer-based instruction in athletic training education" [2 (5.3%)]. Additionally, 3 of the respondents (7.9%) selected an "other" category and reported the following factors: 1) "We're currently reviewing software; however, the selection seems limited," 2) "I am not aware of the availability of computer-assisted instruction and interactive video programs," and 3) "Most of the content covered in my graduate curriculum is not found on any current software."

Software and Instructional Methods

All known athletic training/sports medicine software programs were listed on the survey instrument; respondents were asked to select those they currently used (Table 2). We believed that many program directors might also use software programs which had been developed "in-house" and were not available commercially. Therefore, we also asked respondents to provide information regarding any additional software programs they used for athletic training education purposes (Table 3). With the exception of a few, the commercial availability of most of the software programs listed in Table 3 was unknown.

When asked to report the instructional method used to incorporate computer-based instruction into their curricula, 42 program directors (91.3%) reported using computer-based instruction to supplement other forms of instruction. Other instructional methods used included using computer-based

Table 1. Length of Time for Computer-Based Instruction Use in Athletic Training Education

Time	Respondents	Percentage
Over 5 years	8	17%
Longer than 2 years but less than 5 years	22	46%
Longer than 1 year but less than 2 years	15	31%
Less than 1 year	3	6%

Table 2. Educational Software Used in Athletic Training Education Programs

Name of Program	Vendor/Source	Athletic Training Education Programs Using Program	Percentage
Athletic Training Action - Part 1 (CAI*)	Cramer	36	75%
Athletic Training Action - Part 2 (CAI)	Cramer	36	75%
Athletic Training Action Tutorial (CAI)	Cramer	26	54%
Athletic Training Action Plus (CAI)	Cramer	22	46%
Sports Injuries (CAI)	Cramer	20	42%
Bodyworks (CAI)	Software Marketing Corp	13	27%
Exam Master (CAI)	Cramer	10	21%
ADAM (CAI)	ADAM Software Inc	7	15%
Human Dynamic of Anatomy (IAV†)	Lea & Feiberger	5	10%
Mediclip Graphics Software (CAI)	Mosby	4	8%
Anatomy & Physiology Tutorial (CAI)	Mosby	2	4%
Exploring Medical Language (CAI)	Mosby	1	2%

* CAI, computer-assisted instruction.
† IAV, interactive video.

Table 3. Other Educational Software* Used in Athletic Training Education Programs

Name of Program	Vendor/Source	Type of Program
Body Illustrated: The Anatomical Guide	Spirit of St Louis	CAI†
WRES	CAIS	CAI
‡Alfie Injury Reporting System	Cramer	CAI
Computer Athletic Injury System	Ball State Univ.	CAI
Medical Terminology	Phoenix (through mainframe)	CAI
Emergency Medical Problems	Phoenix (through mainframe)	CAI
First Aid	Phoenix (through mainframe)	CAI
Principles of Electricity	Phoenix (through mainframe)	CAI
Patient Flow Charts	Patient Care	CAI
‡SIMS	Med Sports System	CAI
Exercise Physiology	Developed by Univ of Illinois Ex Phys professor	IAV§
Test Bank, Modern Principles in Athletic Training	Mosby	CAI
AnatLab	College of Medicine (Ohio State Univ.)	IAV
Cyberlog/Sports Medicine Injury and Treatment	Cardinal Health Systems	CAI
Cyberlog/Sports Medicine Rehabilitation and Prevention	Cardinal Health Systems	CAI
Test Items Files (IBM or MAC)	Individual Publishers	CAI
Human Anatomy Series (Series of 7 programs)	Bill Whitehill (Middle Tennessee St. Univ.)	CAI
Anatomy, Mechanisms of Injuries, & Joint Stability Evaluations of the Human Knee	Randy Deere (Western Kentucky Univ.)	CAI

* All programs are DOS-based platforms except for the one indicated as MAC-based.
† CAI, computer-assisted instruction.
‡ Respondents noted that although this software was designed for recording injuries and/or treatments, they also used it for instructional purposes.
§ IAV, interactive video.

instruction as a primary method of instruction [7 (15.2%)], using computer-based instruction in the lecture process via an LCD panel [7 (15.2%)], and using computer-based instruction for testing purposes [16 (34.8%)]. An additional category of "other" was reported by 5 (10.9%) of the respondents who added the following instructional methods: 1) computer-assisted instruction used as part of students' preparation for NATA certification exam, 2) computer-assisted instruction used for research assistance, and 3) computer-assisted instruction used for general review.

Attitude Toward Computer-Based Instruction Use

Using a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree), respondents were asked to rate their level of agreement to statements regarding their attitude toward computer-based instruction use in athletic training education. Seventy-seven respondents (over 89%) agreed or strongly agreed with all four attitude statements (Table 3). Using a similar but separate 5-point Likert scale (1 = very uninterested; 5 = very interested), respondents were also asked to rate their level of interest in attending a formal presentation at the district or national level related to developing and implementing computer-based instruction. Eighty respondents (93%) reported being either very interested [42 (48.8%)] or interested [38 (44.2%)] in attending a presentation on implementing computer-based instruction into the athletic training curriculum. Five (4.7%) of the remaining respondents rated their level of interest in this topic as undecided, while 2 (2.3%) respondents reported being uninterested in this topic. Respondents demonstrated a similar interest in the topic of developing computer-based instruction materials [very interested = 42 (48.8%); interested = 36 (41.9%)].

DISCUSSION

Although computer-based instruction is relatively new to the athletic training profession, results from this study indicate that the percentage of athletic training educators using computer-based instruction is similar to that reported by other allied health professions. As reported earlier, Freeman[13] surveyed allied health education programs and found 43% of them used computer-based instruction while Hebda[16] surveyed nursing baccalaureate programs and found almost 50% of them used this technology.

It is not surprising that athletic training education programs used computer-assisted instruction with greater frequency than interactive video. This lower use of interactive video is similar to that reported by nursing educators. In 1991, Clark surveyed 504 baccalaureate nursing programs on their use of interactive video and found that only 17.9% of the respondents used this technology.[7] We believe the greater use of computer-assisted instruction in athletic training education can be attributed to several factors, including the following:

1. The majority of the athletic training/sports medicine software programs are of the computer-assisted instruction format.
2. Computer-assisted instruction programs are usually less expensive than interactive video programs.
3. Most interactive video programs require the purchase of expensive, "high-end" hardware components such as laser disc players, video playback cards, and an increased amount of random access memory (RAM).

Rizzolo[28] referred to interactive video as a technology "somewhat ahead of its time." Using Delphi research techniques, she identified 12 key factors which nursing educators reported as impeding their use of interactive video. The five highest ranking factors included: 1) hardware/software incompatibility, 2) cost of developing interactive video software, 3) lack of time for faculty to devote to designing such software, 4) few well-designed interactive video programs, and 5) a lack of knowledge of the power and use of interactive video. Athletic training educators reported very similar factors preventing their use of computer-based instruction. Budget restraints was the most common factor cited by athletic training educators for not using computer-based instruction while "never thought of using computer-assisted instruction or interactive video" represented the second most common factor impeding the use of computer-assisted instruction or interactive video.

It is certainly understandable that a limited budget can prevent the use of computer-based instruction. There are several possibilities, however, which might enable less fortunate programs to use this technology. For example, external funding obtained through grants can often provide programs with the necessary funds to purchase computer hardware and software as well as possibly support the development of new software. Additionally, athletic training educators should consider combining funds and/or resources with other related departments or areas to purchase equipment and software. This type of joint endeavor may enable programs to set up a shared computer resource center for the instruction and subsequent interaction of students from a variety of allied health areas (ie, athletic training, physical therapy, nursing, etc). Many programs may have the funds to purchase software, yet lack the funds to purchase computer hardware. This problem may be alleviated by placing the software on an institution's local area network, thus providing students with access to athletic training software from campus computer labs.

When discussing the use of computer-based instruction software, it is important to also discuss the various types of software. Both computer-assisted instruction and interactive video programs typically use one of the following formats to present instructional information: tutorial, drill and practice, or simulations. At one time, these formats were viewed as distinct and separate; however, they are now often combined to provide a variety of educational stimuli. The tutorial format presents new information to a learner, asks questions of the learner throughout the lesson to check for understanding, and provides immediate feedback and/or remediation according to the learner's responses. Drill and practice formats provide for learning through a repetitious process of asking questions or presenting problems to be answered or solved by the learner while again providing feedback or remediation where appropriate. Simulations, particularly those in the allied health professions, are designed to portray real-life scenarios and to provide students with the opportunity to develop decision-making skills in a nonthreatening environment.

In 1992, Cohen and Dacanay reported that allied health professions educators have placed a particular emphasis on the use of computerized simulations.[8] Our results indicate a similar emphasis in athletic training education. The four software programs used most frequently by athletic training education programs (the Athletic Training Action programs) use the simulation format of instruction (Table 2).

Our results indicate that there are also a number of software programs being used in athletic training education which are not available commercially (Table 3). Further, there is reason to believe that there may be other "noncommercial" software programs which are used by athletic training internship programs. For this reason, we believe that it would be beneficial to establish a clearinghouse for such software and/or create a network for identifying such software. Perhaps a computer software shareware program should be developed specifically for athletic training educators and students.

Implementing computer-based instruction software into the athletic training curriculum, like implementing any other media, requires the use of sound instructional methods. The responding program directors reported using computer-based instruction software most often to supplement their "traditional" methods of instruction. Hemlo reported that supplemental use of computer-assisted instruction was also the most predominant instructional method for implementing this technology in health professions education.[17] Research also strongly supports the effectiveness of using computer-based instruction as a supplemental form of instruction.[17,33]

The overall positive attitudes of the responding athletic educators toward computer-based instruction use is promising. The responses of the program directors who participated in this study have implications for all athletic training educators as well as

Table 4. Attitudes of Program Directors Toward Computer-Based Instruction Use in Athletic Training Education

Statement	Strongly Disagree n(%)	Disagree n(%)	Undecided n(%)	Agree n(%)	Strongly Agree n(%)
CBI*, when appropriately implemented, can enhance the educational process of the student athletic trainer.	1 (1.2)	0 (0)	5 (5.8)	42 (48.8)	38 (44.2)
The implementation of CBI in athletic training education programs should be encouraged.	1 (1.2)	1 (1.2)	5 (5.8)	46 (53.5)	33 (38.4)
There is a need for increased development of athletic training educational software.	1 (1.2)	1 (1.2)	4 (4.7)	27 (31.4)	53 (61.6)
There is a need for increased research to investigate and identify the factors which influence the effectiveness of CBI in athletic training education.	1 (1.2)	1 (1.2)	7 (8.1)	45 (52.3)	32 (37.2)

* CBI = computer-based instruction.

those individuals who plan the continuing education activities for athletic training educators. The responding program directors overwhelmingly agreed (or strongly agreed) that there is a need for the following: 1) increased development of athletic training educational software and 2) further research to identify the factors which influence the effectiveness of computer-based instruction in athletic training education (Table 4). Additionally, they expressed favorable interest (interested and very interested) in attending presentations at either the district or national level which would focus on the development and implementation of computer-assisted instruction and interactive video materials.

This study was an initial attempt to examine the use of computer-based instruction in athletic training education. Although our findings are limited to the use of computer-based instruction in NATA-approved athletic training education programs, we believe the descriptive data provided can be useful to all those who educate athletic training students, regardless of whether they work in curriculum or internship programs. Additionally, athletic training educators interested in using computer-assisted instruction or interactive video can benefit from the previous research efforts of not only their colleagues in athletic training education[4,6,9,12,14,18,31,32,34] but also their fellow educators from other allied health professions[2,3,10,15,21,23,30,33] and higher education in general.[1,11,19,20,22,25] However, as noted by the participants of this study, further research is still needed to examine the effectiveness of this technology in athletic training education specifically.

As more athletic training/sports medicine software programs are developed and implemented into the athletic training curricula, we challenge athletic training educators and researchers to seek answers to the following questions: 1) Which athletic training content areas are best suited for the effective use of computer-based instruction? 2) Which methods of implementation are most effective (ie, required versus voluntary, NATA certification test preparation, introduction of material versus review of material, etc)? and 3) Which types of athletic training students benefit most from computer-based instruction (ie, high-ability learners versus low-ability, students with one learning style versus students with another learning style, etc)?

ACKNOWLEDGMENT

This research study was funded through a College of Education research grant from The University of Alabama in Tuscaloosa, AL.

REFERENCES

1. Adams TM, Waldrop PB, Justen JE. Effects of voluntary vs required computer-assisted instruction on student achievement. *Phys Educ.* 1989; 46:213–217.
2. Barker SP. Comparison of effectiveness of interactive videodisc versus lecture-demonstration instruction. *Education.* 1988;68:699–703.
3. Belfry MJ, Winne PH. A review of the effectiveness of computer assisted instruction in nursing education. *Comput Nurs.* 1988;6:77–85.
4. Buxton BP, Speitel TW, Holgen KA. Comparison of effectiveness of an interactive computer enhancement program versus textbooks for practical application of athletic training assessment skills. *J Athl Train.* 1995; 30(suppl):S-27. Abstract.
5. Charron H, Evans P, Korpela A. Using computer-assisted instruction as an alternative. *Nurs Educ Microworld.* 1990;4:44.
6. Chen A, Buxton BP, Holgen KA, Speitel TW. The effects of an interactive computer program on knowledge structures in athletic training. *J Athl Train.* 1995;30(suppl):S-27. Abstract.
7. Clark CE. Interactive videodisc: its place in today's nursing curricula. *Comput Nurs.* 1991;9:210–214.
8. Cohen PA, Dacanay LS. Computer-based instruction and health professions education. *Eval Health Prof.* 1992;15:259–281.
9. Deere R, Wright KE, Solomon AH, Whitehill W. A comparison of student knowledge retention following instruction using computer-assisted instruction versus lecture method for an undergraduate athletic training program. *J Athl Train.* 1995;30(suppl):S-28. Abstract.
10. Dengler PE. Computer-assisted instruction and its uses in occupational therapy education. *Am J Occup Ther.* 1983;37:255–259.
11. Evans AD. Interactive video research: past studies and directions for future research. *Int J Instr Media.* 1986;13:241–249.
12. Fincher AL. *Effect of Learning Style on Cognitive and Psychomotor Achievement and Retention When Using Linear and Interactive Video.* Tuscaloosa, AL: The University of Alabama; 1995. Dissertation.
13. Freeman AW. Computer use in allied health programs. *J Allied Health.* 1987;16:177–183.
14. Gould GR, Ransome JW, Conry B, Chan K. Multimedia computer-assisted learning programs. *J Athl Train.* 1995;30(suppl):S-28. Abstract.
15. Guy JF, Frisby AJ. Using interactive videodiscs to teach gross anatomy to undergraduates at The Ohio State University. *Acad Med.* 1992;67:132–133.
16. Hebda T. A profile of the use of computer-assisted instruction in baccalaureate nursing education. *Comput Nurs.* 1988;6:22–29.
17. Hmelo E. Computer-assisted instruction in health professions education: a

review of the published literature. *J Educ Technol Systems*. 1989;18:83–101.
18. Holgen KA, Buxton BP, Speitel TW. The effect of an interactive computer enhancement program on cognitive athletic training knowledge. *J Athl Train*. 1995;30(suppl):S-21. Abstract.
19. Justen JE, Adams TM, Waldrop PB. Effects of small group versus individual computer-assisted instruction on student achievement. *Educ Technol*. Feb 1988;50–52.
20. Justen JE, Waldrop PB, Adams TM. Effects of paired versus individual user computer-assisted instruction and type of feedback on student achievement. *Educ Technol*. Jul 1990;51–53.
21. Kramer TA, Polan HJ. Communications: uses and advantages of interactive video in medical training. *J Med Educ*. 1988;63:643–644.
22. Kulik CC, Kulik JA. Effectiveness of computer-based education in colleges. *Assoc Educ Data Syst J*. 1986;19:81–108.
23. Lassan R. Use of computer-assisted instruction in the health sciences. *Nurs Forum*. Apr 1989;23:13–17.
24. Levine RS, Jones JH, Morgan C. Comparison of computer-assisted learning with tutorial teaching in a group of first-year dental students. *Med Educ*. 1987;21:305–309.
25. McNeil BJ, Nelson KR. Meta-analysis of interactive video instruction: a 10 year review of achievement effects. *J Comput-Based Instr*. 1991;18:1–6.
26. NATA. *Nata Approved Athletic Training Education Programs 1993-1994: List of Program Directors*. Terre Haute, IN: National Athletic Trainers Association's Professional Education Committee; 1993.
27. Pazdernik TL, Walaszek EJ. A computer-assisted teaching system in pharmacology for health professionals. *J Med Educ*. 1983;58:341–348.
28. Rizzolo M. Factors influencing the development and use of interactive video in nursing education: a delphi study. *Comput Nurs*. 1990;8:151–159.
29. SAS Institute, Inc. SAS User's Guide: Statistics. Cary NC: SAS Institute, Inc; 1985.
30. Sizemore MH, Pontious S. Computer-assisted instruction promotes nursing student mastery of health history taking. *J Comput-Based Instr*. 1987;14:62–67.
31. Speitel TW, Buxton BP. Interactive athletic training enhancement curriculum (IATEC) design and development. *J Athl Train*. 1995;30(suppl):S-20. Abstract.
32. Thomas BR. *Effects of Computer-assisted Instruction on Both Student Learning and Student Perception of Instructional Methods*. Tuscaloosa, AL: The University of Alabama; 1993. Dissertation.
33. Thompson EC. Computer-assisted instruction in curricula of physical therapist assistants. *Phys Ther*. 1987;67:1237–1239.
34. Wright KE, Fincher AL. Computer-based instruction in athletic training education programs. *J Athl Train*. 1995;30(suppl):S-27. Abstract.

Navigating the Library Maze: Introductory Research and the Athletic Trainer

William R. Whitehill, EdD, ATC; Pat Norton, MLS; Kenneth E. Wright, DA, ATC

ABSTRACT: Access to computerized databases is making the process of research much easier. However, many novice researchers are unaware of the benefits of this technology and/or the different formats (eg, CD-ROM, DIALOG, or Internet) through which this information can be accessed. The focus of this article is to acquaint the beginning researcher with alternative methods of conducting research in the electronic age. An understanding of the procedures used to conduct a database search and careful organization of ideas before searching will yield better results. Examples of the planning phase and results of a search in both MEDLINE and SPORT databases are provided.

Computerized databases have changed the process for conducting research and literature reviews.[6] Before the development of technology to electronically access information from around the world, research was limited by distance, time, language, and money. Although financial constraints still exist, researchers can access and obtain information instantaneously from around the world, often translated into their native language. This information, formerly available only in printed form, is now available both on-line and in compact disc read only memory (CD-ROM) formats.[5] In addition, increasing numbers of educational institutions and libraries are offering the services of information specialists whose jobs consist of assisting patrons to determine the most efficient, cost-effective method for fulfilling their information needs.

Perhaps you have just read a timely, pertinent article that seems to have been written expressly for you or your school. The author has used a number of references which are certain to provide additional information and would be well worth the time spent reading them. There is just one problem: your library does not have the referenced materials. So how can the information be located? Depending upon the size of your school, this could be as simple as going to a different library on your campus. In this case, the library you use most often should have a listing of all the journals or books available on campus and which library houses them. Other formats for research are also available for the investigator.

CD-ROM

A relatively new technology which is now common at most 4-year colleges and universities is the CD-ROM. These discs look and work just like compact discs (CDs) played on home stereo systems. However, they contain the basic information to further an investigation of a wide range of journals, magazines, and other sources; plus the information is visual rather than aural. The librarian can demonstrate this technology and a search for information can be performed in a variety of ways: by topic (ie, anterior cruciate ligament reconstruction using an allograft), by year, or by author.[8] When articles are located, you press the appropriate key and the computer will send a copy of the article to the printer. The number of journals in this format varies by library; however, most major journals are now available on CD-ROM.

Libraries offering databases on CD-ROM usually have a terminal set up for patron use. Although these databases are generally menu-driven and simple to use, you still need to know at least the general subject area to be searched. CD-ROMs are useful when you have a specific topic, and are excellent resources for "browsing" a topic (selecting a broad category and looking at all the information that falls under it).[3] If your library has CD-ROM disks, you can "browse" the system at no cost. Only when you need resources from outside of your institution (ie, securing an abstract or electronic services) is there a fee involved.

ELECTRONIC DATABASES

Another method for retrieving information is electronic database searching via telephone modem. Some of the most commonly used databases for athletic training information are MEDLINE,[1] CINAHL, SPORT, and ERIC.[9] Each of these databases has its own specialization:

- MEDLINE—a broad range of medical literature from professional journals;
- CINAHL—nursing and allied health literature which is more technical in nature and written for both physicians and allied health personnel;
- SPORT—practical and technical/medical information relating to sports and athletics;
- ERIC—educational/pedagogical perspectives of sport and athletics.

It is possible that a library might offer access to only one or two of these electronic database systems; nevertheless, most subscribe to services such as DIALOG[3] or Internet[7] which offer many diverse databases. DIALOG provides access to

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Table 1. How to Plan a Search

1. Select a topic (ie, ACL rehabilitation).
2. Narrow the topic to a specific area of interest (ie, review of current postsurgical rehabilitation modalities for athletes).
3. How much information do you think will be available (two to three articles or 200 to 300)?
4. How much information do you need? (The more you request, the more expensive the search will become.)
5. How far back do you need to search? (The past year, 5 to 10 years, or as far back as the database will go.)
6. Do you want to limit the search in any other way? (only English articles, only articles with abstracts, only articles appearing in certain journals, or only articles with a certain key word in the title, etc)
7. How do you want your search printed out? (bibliographic citation only, citation and abstract, or full citation with abstract and indexing)
8. What are the key search terms to be used?

several hundred databases covering subjects ranging from technology and business to the arts and entertainment. Each database has its own access charges (usually by the hour) plus a charge for each citation retrieved. The Internet is a loosely structured electronic network involving a "national research-oriented network comprised of over 3,000 government and academic networks in 40 countries."[4] Because of its size, a front-end program, such as Gopher, facilitates searching by providing well-marked access points (eg, science, medicine, or literature) to the various networks and, when the search is over, makes leaving the Internet easier. Some libraries permit patrons to do their own searches, but training and practice can make one proficient at database searching.[2] Usually, the information specialist or librarian does the database searching.

CONDUCTING A SEARCH

The librarian (information specialist) will initially conduct an interview to determine what type of information you are seeking and the best sources for the information. Carefully developing and organizing ideas beforehand will provide better search results.[2] Table 1 provides some sample preliminary steps in formulating and requesting a literature search.

For example, you are planning to write an article on anterior cruciate ligament (ACL) rehabilitation. The scope of the database search could be narrowed specifically to review articles of postsurgical rehabilitation modalities used for athletes. You want to ensure that no articles older than 3 years will be requested and, of that group, you want only those published in English. There are probably numerous articles regarding the original, broad topic (ACL rehabilitation), but by limiting this search to a specific group of articles, the expected number is less than 100. Because the article to be written is a review, all relevant articles are needed. If this were not a review article, abstracts as well as the bibliographic citations could be requested from the search to avoid the expense of requesting copies of nonrelevant articles. This may add to the initial cost of the search, but can save time and/or money in the long run.

The search terms selected may vary, depending upon the database chosen. The librarian should have a thesaurus that will aid in selecting the terms used (ie, can you search for knee injuries or must you use anterior cruciate ligament injuries?) by the particular database. If you are having trouble selecting the ideal terms, try to locate an article that covers exactly the subject matter you are researching. The librarian can search for that article and, depending upon the database, find the key terms (called indexing) associated with it. This provides a good starting point for choosing search terms.

Table 2 shows the terms for the ACL reconstruction search and the resulting number of citations in both MEDLINE and SPORT databases. This table is computer-generated and intended to imitate what the athletic trainer would view during the search.

This search yielded 47 citations: MEDLINE had 26 references and SPORT had 21. An examination of the printouts revealed that 7 (15%) of these citations appeared in both databases. This sometimes occurs when searching multiple databases due to some overlapping of the journals indexed by the different databases. However, the number of duplicated articles is usually small, as it was in this example.

OBTAINING THE ARTICLES

Once you receive the results of the search, review them to decide whether they provided the information you sought. If so, it is merely a matter of getting the articles either from the library or through the interlibrary loan office. If not, discuss

Table 2. Key Terms for Searching and Results

Key terms
1. Anterior cruciate ligament
2. Surgery
3. Rehabilitation
4. Athlet?*
5. PY = 1991:1994†

Examples of searches in MEDLINE and SPORT

MEDLINE	
1. Anterior Cruciate Ligament	1670
2. (1) limited to English	1318
3. (2) and (surgery or reconstruction)	866
4. (3) and rehabilitation	161
5. (4) not animal‡	152
6. (5) and athlet?	55
7. (6) and PY = 1991:1994	26
SPORT	
1. Anterior Cruciate Ligament	608
2. (1) limited to English	559
3. (2) and (surgery or reconstruction)	327
4. (3) and rehabilitation	160
5. (4) and athlet?*	40
6. (5) and PY = 1991:1994	21

* This is known as truncation and permits retrieval of any term beginning with "athlet"—ie, athlete, athletes, athletic, athletics, athleticism, etc.

† This limits the search to those articles published within the last 3 years (PY = publication year).

‡ MEDLINE often reports studies performed on animal populations. This step eliminates those studies.

with the librarian why this is not the information needed and attempt to find better terms to use in the search.

All libraries can obtain articles through interlibrary loan. Generally, you complete a form requesting an article, book, or monograph and turn it in to the librarian. The interlibrary loan department will verify the existence of the document, find a library which has it, and send a message to that library requesting a copy. The introduction of automation into the library has had a great impact on this department. While retrieving articles formerly took up to 2 months, articles can now be requested and received in 7 to 10 working days. If your library has a fax machine, it may be possible to receive an article within an hour. However, with this service there are increased costs (ie, price per page and a processing fee).

There are also document delivery services. If your library does not subscribe to one, it can provide information on setting up an individual account. Generally, you contract with the service for a certain number of articles per year at a set price per article. How well this service will work for you depends, to a large extent, on your ability to anticipate the number of articles you will request.

Your librarian can help you decide which of these resources will work best for you. These information managers are willing to assist the patron in becoming self-sufficient and confident in using the computer technology available in the library. No matter where you are, library automation makes information retrieval as simple as asking for help.

REFERENCES

1. Bader SA, Piemme TE. A study on the selection and utilization of MEDLINE search systems. ERIC Document: ED331525.
2. Clever EC, Dillard DP. Physical education research–computerized databases in an interdisciplinary field. *J Phys Educ Recr Dance*. 1993;64:67–72.
3. Feustle JA. Electronic database: a brief survey. *Hispania*. 1988;71:724–728.
4. Freedman A. *The Computer Glossary*. 6th ed. New York, NY: American Management Association; 1981:286.
5. Henriksen P. Information tectonics: the emergency of a new key discipline in information technology. *Microcomput Info Manage*. 1991;8:241–253.
6. LaGuardia C, Bentley S. Electronic databases: will old collection development policies still work? *Online*. 1992:16:60–63.
7. Mikita EG, Drusedum LA. Introducing health sciences librarians to the Internet. *Med Ref Serv Q*. Fall 1993;12:1–11.
8. Reihm SM. A first look at firstsearch. *Online*. 1992;16:42–44,46,48,51–53.
9. Tenopir C. The most popular databases. *Libr J*. 1991;116:96,98.

Femoral Stress Fracture

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ABSTRACT: The following case report describes the history of a high school football player who complained of right anterior thigh pain, which worsened during the season. The team orthopedic surgeon made an initial diagnosis of a right rectus femoris strain. The athlete was treated and improved quickly. One week later, his condition worsened and he reported signs and symptoms similar to those experienced initially. A follow-up examination by the orthopedic surgeon revealed a femoral stress fracture to the proximal one-third (medial side) of the right femur. We describe the athlete's clinical findings, diagnostic tests, and rehabilitation program. We also discuss the pathophysiology and treatment principles relevant to the management of a femoral shaft stress fracture. The athlete has recovered and has returned to full athletic activity with no complications.

Stress fractures are becoming more common in athletics.[6,9,16,24] Most occur in those sports classified as run-oriented, eg, track and field, and cross-country.[1,3,5,14,16,18,23] The site most commonly injured is the tibia.[9,16,18,22,23,26]

Femoral stress fractures have been relatively uncommon in athletics,[3,13–15] but abundant in the military.[2,8,19,20,26] Most of those documented in athletics have been seen in runners.[1,3,10,14] They have been reported occasionally in basketball, baseball, and tennis,[10,23] but seldom occur in football. In our review of the literature, we found only three femoral stress fractures occurring in football, one on the neck and two on the mid one-third of the shaft.[11,23] Stress fractures to the femur can occur at the neck,[3,6,14,18] the shaft,[3,10,14,18] and the condyle,[2,12,18,22] with the highest incidence occurring at the neck.[3,6,18,24]

The purpose of this article is to review the clinical presentation, diagnostic testing, and rehabilitation of a femoral shaft stress fracture that occurred to a high school football player under our care. We emphasize the importance of obtaining an in-depth history and patient evaluation, and the importance of having a high index of suspicion of a femoral stress fracture with persistent thigh pain.

CLINICAL PRESENTATION

An 18-year-old male caucasian high school football player, (5 ft 11 in; 165 lb) playing free safety, complained of anterior thigh pain that he had experienced for about a week. The onset of his symptoms started 5 weeks into the season. He reported having experienced a "pulling" sensation in his right thigh during a game on the night before examination. There was no direct trauma to the region. Signs and symptoms included: 1) pain over the rectus femoris, 2) tenderness over the rectus femoris, 3) mild swelling, 4) no discoloration, 5) pain during active knee extension, 6) pain during active hip flexion, 7) pain during passive knee flexion, 8) pain during passive hip extension, 9) painless internal/external rotation of the hip, 10) minimal muscular weakness, 11) normal biomechanical alignment, 12) normal neurological exam, and 13) slight limp on gait analysis.

The team orthopedic surgeon diagnosed his injury as a right rectus femoris muscle strain. Treatment included icing, stretching, and range-of-motion exercises. His condition improved significantly and he returned to full activity within 3 days.

Approximately 1 week later, he was observed running with an antalgic gait. He reported symptoms similar to those experienced initially. A follow-up physical examination revealed no swelling or deformity. However, there was localized tenderness at the mid shaft of the right femur. His neuromuscular status remained normal. He was instructed to see the team orthopedic surgeon. However, because of insurance coverage restrictions, he was seen initially by his family doctor. X-rays were obtained and revealed possible callus formation to the proximal one-third (medial side) of the right femur (Fig 1).

The athlete was referred to the team orthopedic surgeon for follow-up tests. Diagnostic testing included a Technetium 99, triple-phase bone scan given 1 week after the initial x-ray. The bone scan demonstrated increased uptake at the proximal third

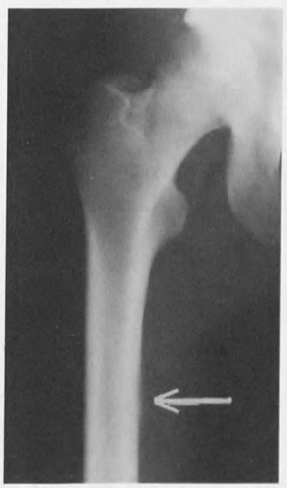

Fig 1. Initial x-ray revealing possible callus formation to the proximal third (medial side) of the right femur.

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of the right femur (Fig 2). Two weeks after the bone scan, x-ray revealed evidence of a healing stress fracture to the proximal one-third (medial side) of the right femur (Fig 3). These findings were consistent with the diagnosis of a right proximal one-third, femoral shaft stress fracture.

For the first 5 weeks, he maintained his upper body strength and cardiovascular conditioning by using the upper extremity apparatus of a Schwinn Airdyne (Schwinn, Taiwan) stationary bike and weight lifting. We eliminated running and jumping activities during this period. Six weeks after the initial diagnosis, we initiated a functionally progressive rehabilitation program consisting of 2 weeks of nonweight bearing activities in a pool and on a stationary bike (Table 1). Sports-specific weight-bearing activities were then initiated for 1 week (Table 2). He was then gradually allowed to return to sports activity. He was able to return for the start of the basketball season, 9 weeks after the initial diagnosis. He has had no further complications.

An x-ray was obtained before the initiation of basketball and revealed full healing of the femoral shaft stress fracture (Fig 4). Our criteria for return to full sports activity included: 1) evidence of healing on x-ray, 2) pain-free and full range of motion, 3) normal running and walking gait, 4) comparable strength bilaterally, and 5) fulfillment of our rehabilitation protocol.

DISCUSSION

A stress fracture is defined as a partial or complete fracture to a bone in response to an increased level of nonviolent stress that is applied in a rhythmic, subthreshold manner.[3,6,10,18] The cause of femoral shaft stress fractures is unknown. The following theories are presented in the literature: 1) once a muscle is fatigued, it loses its shock-absorbing qualities, thus transferring the stress to the bone, [1,9,15,16,24] 2) the cyclic overload of a bone,[3,6] and 3) the increased muscular force applied across a bony attachment.[3,6,9,15,16]

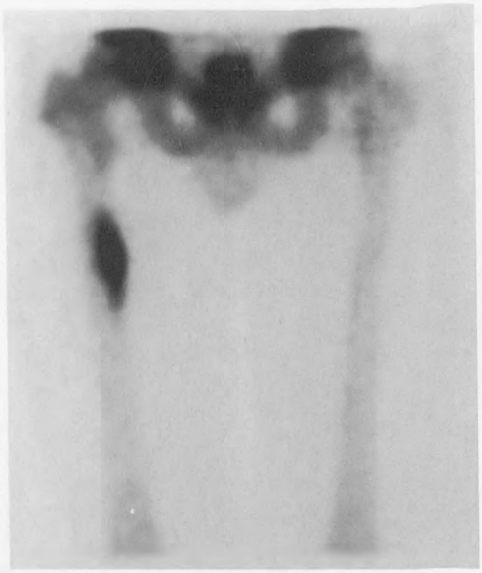

Fig 2. Triple-phase bone scan showing increased uptake at the proximal third (medial side) of the right femur.

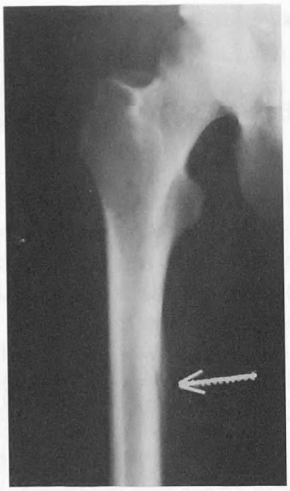

Fig 3. Second x-ray showing evidence of a healing femoral stress fracture to the proximal third (medial side) of the right femur.

Table 1. Nonweight-Bearing Rehabilitation

Warm-up:	light warm-up, then stretch pertinent extremity
Pool Activity*	
Agility:†	1) side shuffle 2) carioca 3) back pedal 4) high knee
Jogging:†	1) straight 2) S pattern 3) Z pattern
Tread Water:	chest deep or more in water start with 3 sets, progress as needed 1) jog 15 sec 2) sprint 15 sec 3) jog 15 sec 4) sprint 15 sec 5) jog 15 sec 6) sprint 15 sec 7) jog 15 sec 8) 30 to 45 sec rest (completion of one set)
Bike:	5 to 10 minutes, progress as needed 1) 1 min warm-up 2) 15 sec sprint 3) 30 sec normal pace 4) 15 sec sprint 5) 30 sec normal pace etc—continue until time is up

* Must have lifeguard supervision for pool activities.
† 40 to 50 yards up and back (twice at each activity).

Risk factors associated with femoral shaft stress fractures include: 1) a sudden increase in training (mileage, intensity, or frequency),[3,6,18] 2) a change in running surface or terrain,[3,6,18,24] 3) improper or inappropriate footwear,[6,18,24] 4) a biomechanical abnormality,[16,18,24] and 5) nutritional and hormonal factors.[7]

Signs and symptoms that may suggest a femoral stress fracture are: 1) diffuse or localized pain with an insidious onset that worsens with activity,[6,13,18,21] 2) point tenderness on palpation,[14,16,18,21] 3) diffuse or localized swelling,[9,16,21] 4) an antalgic gait,[14,26] 5) painful passive and active range of motion

Table 2. Weight-Bearing Rehabilitation

Warm-up:	light warm-up then stretch pertinent extremity
Walking:	1) straight* 2) S patterns* 3) Z patterns*
Agility:	1) slide board catching a football for 2 minutes 2) side straddle* 3) carioca* 4) high knees* 5) hopping* 6) back peddle (butt as low as possible)*
Jogging:	1) straight* 2) S patterns* 3) Z patterns*
Sprinting:	1) 40 to 50 yd up and back 2) 40 to 50 yd starting and stopping on command 3) 20 yd (back to start), 40 yd (back start), and 60 yd (back to start)
Cool Down:	end with an active cool down and stretching activities

* 40 to 50 yards, up and back altering the pace (twice at each activity).

of the hip and/or knee,[14,24] 6) positive "one-legged hop" test,[16] 7) positive "fist" test,[19] and 8) positive "fulcrum" test.[11]

Two clinical tests used to better differentiate between asymptomatic and symptomatic femoral stress fractures are the "fist" and "fulcrum" tests. During the "fist" test, bilateral pressure is applied to the anterior femur starting distally and moving proximally.[19] The examiner is looking for variation from side to side and areas of localized tenderness.[19] During the "fulcrum" test, the examiner's arm is placed under the distal thigh while gentle pressure is applied to the dorsum of the knee; the procedure is repeated with the arm under the proximal thigh (Fig 5).[11] A positive test would include increased discomfort, often described as sharp pain, and accompanied with apprehension.[11]

The incidence of proximal one-third femoral stress fractures is unclear. According to one study on military recruits, of all the stress fractures reported, 11.4% occurred at the proximal one-third.[20] A study[18] using runners reported 5% of all stress fractures occurred at the proximal one-third. A recent study[11] using athletes, found an overall incidence of 20.6% for stress fractures of the femoral shaft, with six of the eight reported cases occurring at the proximal one-third. Several other studies[8,9,16] have reported the incidence of femoral stress fractures, but have failed to differentiate the location of the fracture. Further research looking at large athletic populations is needed to get accurate data pertinent to occurrence in athletics.

There are several associated risks of undetected femoral stress fractures at the shaft and neck. If unrecognized, they may lead to displaced fractures.[4,7,15,17,24,25] An early diagnosis is required for prevention. Femoral stress fractures are often misdiagnosed as a muscle strain to the quadriceps, thus hindering an early correct diagnosis.[1–3,7,10,17,19] In addition, initial x-rays are often negative. X-rays are not positive until 2 to 4 weeks after the onset of symptoms[14] and are only positive in one-half of the cases.[20,25,26] Other considerations relevant to obtaining an early correct diagnosis include: 1) they are often

Fig 4. Final x-ray showing healing at the proximal third (medial side) of the right femur.

asymptomatic[3,9,15,19,20] and only detected by triple-phase bone scans; 2) they can occur bilaterally[1,6,21,26]; 3) they may reoccur close to the original area[3]; and 4) they may be misdiagnosed as a malignant tumor.[3,5,6,13,18]

A triple-phase bone scan is recommended for an early diagnosis.[3,14,18,24] It is very important to perform an adequate evaluation, patient history, and have a high index of suspicion. This will enable the practioner to justify having a bone scan performed and thereby decrease the incidence of undiagnosed asymptomatic femoral shaft stress fractures.

A conservative rehabilitation program is recommended because of the risk of developing a displaced fracture. Initial treatment includes a period of protected weight bearing for 1 to 4 weeks.[6] You should determine the time needed for protected weight bearing by the patient's signs and symptoms, initial x-rays, and bone scan results. Several authors[3,6,10] recommend a period of nonweight bearing or partial weight bearing on crutches. This should be used if the athlete is having difficulty during normal ambulation. The most common rehabilitation activities are swimming and biking.[4,6,10] Any combination of

Fig 5. Examiner's arm is placed under the distal thigh while gentle pressure is applied to the dorsum of the knee; the procedure is repeated with the arm under the proximal thigh.

these activities can be used. We have presented the rehabilitation program used in this particular case, but it must be individualized to the athlete's needs. Athletes usually return to full activity within 8 to 14 weeks, depending on signs and symptoms and x-ray evidence of bone healing.[3,4,10,16]

Femoral shaft stress fractures are uncommon in contact and collision sports, but are being seen more frequently in runners. This particular case demonstrates that stress fractures to the shaft of the femur can occur in contact and collision sports. This article attempts to make the athletic trainer aware of femoral shaft stress fractures and the possible complications associated with this injury. An early diagnosis is needed. Often, x-rays are not going to detect these injuries. Therefore, we must go through the appropriate referral channels to have a triple-phase bone scan ordered. One needs to maintain a high level of suspicion, especially if the athlete is experiencing persistent pain that shows no improvement with treatment.

REFERENCES

1. Blatz DJ. Bilateral femoral and tibial shaft stress fractures in a runner. *Am J Sports Med.* 1981;9:322–325.
2. Brudvig-Schmidt TJ. Distal femoral stress fractures in military basic trainees: a report of three cases. *J Orthop Sports Phys Ther.* 1985;7:20–22.
3. Butler JE, Brown SL, McConnell BG. Subtrochanteric stress fractures in runners. *Am J Sports Med.* 1982;10:228–232.
4. Clement DB, Ammann W, Taunton JE, et al. Exercise induced stress injuries to the femur. *Int J Sports Med.* 1993;14:347–352.
5. Daffner RH, Martinez S, Gehweiler JA. Stress fractures in runners. *JAMA.* 1982;247:1039–1041.
6. DeLee JC, Drez D. *Orthopaedic Sports Medicine Principles and Practice.* Philadelphia, PA: WB Saunders Co; 1994;2:1086–1112.
7. Dugowson CE, Drinkwater BL, Clark JM. Nontraumatic femur fracture in an oligomenorrheic athlete. *Med Sci Sports Exerc.* 1991;23:1323–1325.
8. Finestone A, Shlamkovitch N, Eldad A, et al. Risk factors for stress fractures among Israeli infantry recruits. *Milit Med.* 1991;10:528–530.
9. Ha KI, Hahn SH, Chung M, Yang BK, Yi SR. A clinical study of stress fractures in sports activities. *Orthopedics.* 1991;14:1089–1095.
10. Hershman EB, Lombardo J, Bergfeld JA. Femoral shaft stress fractures in athletes. *Clin Sports Med.* 1990;9:111–119.
11. Johnson AW, Weiss CB, Wheeler DL. Stress fractures of the femoral shaft in athletes more common than expected. A new clinical test. *Am J Sports Med.* 1994;22:248–256.
12. Lafforgue P, Acquaviva PC. Stress fracture in the medial femoral condyle: a case report. *Acta Orthop Scand.* 1992;63:563–565.
13. Levin DC, Blazina ME, Levine E. Fatigue fractures of the shaft of the femur: simulation of malignant tumor. *Radiology.* 1967;89:883–885.
14. Lombardo SJ, Benson DW. Stress fractures of the femur in runners. *Am J Sports Med.* 1982;10:219–227.
15. Luchini MA, Sarokhan AJ, Micheli LJ. Acute displaced femoral shaft fractures in long distance runners. *J Bone Joint Surg [Am].* 1983;65A: 689–691.
16. Matheson GO, Clewment DC, McKenzie JE, Taulton DR, Lloyd-Smith DC, McIntyre JG. Stress fractures in athletes: a case study of 320 cases. *Am J Sports Med.* 1987;15:46–58.
17. Mendez AA, Eyster RL. Displaced nonunion stress fractures of the femoral neck treated with internal fixation and bone graft: a case report and review of the literature. *Am J Sports Med.* 1992;20:230–233.
18. McBryde AM. Stress fractures in runners. *Clin Sports Med.* 1985;4:737–752.
19. Milgrom C, Finestone A, Shlamkovitch N, et al. The clinical assessment of femoral stress fractures: a comparison of two methods. *Milit Med.* 1993;158:190–192.
20. Milgrom C, Giladi M, Stein H, et al. Stress fractures in military recruits. *J Bone Joint Surg [Br].* 1985;67B:732–735.
21. Pester S, Smith PC. Stress fractures in the lower extremities of soldiers in basic training. *Orthop Review.* 1992;21:297–303.
22. Rosen PR, Micheli LJ, Treves S. Early scintigraphic diagnosis of bone stress and fractures in athletic adolescents. *Pediatrics.* 1982;70:11–14.
23. Rupani HD, Holder LE, Espinola DA, Engin SI. Three phase radionuclide bone imaging in sports medicine. *Radiology.* 1985;156:187–196.
24. Sterling JC, Webb RF, Meyers MC, Calvo RD. False negative bone scan in a female runner. *Med Sci Sports Exerc.* 1993;25:179–185.
25. Visuri T. Displaced stress fracture of the femoral shaft: a report of three cases. *Milit Med.* 1992;157:325–327.
26. Visuri T, Vara A, Meurman KOA. Displaced stress fractures of the femoral neck in young male adults: a report of twelve cases. *J Trauma.* 1988;28:1562–1569.
27. Wilson ES, Katz FN. Stress fractures: an analysis of 250 consecutive cases. *Radiology.* 1969;92:481–486.

Unloaded Treadmill Training Therapy for Lumbar Disc Herniation Injury

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ABSTRACT: The low back region is an area that is very susceptible to injury in athletes. Running is an activity that can be significantly affected by chronic overuse stress. The athlete presented in this case report suffered a herniation of the disc between L-4 and L-5 while training for and racing in a national championship marathon. The athlete was placed on a treatment program of heat, electrical muscle stimulation, and strength and flexibility exercises. The athlete also continued to train by unloaded treadmill training therapy. Unloaded treadmill training therapy produced an effect that reduced stress on injured joints and tissue. This enabled the athlete to maintain fitness while running pain-free on this specialized equipment. The athlete trained twice a week for 16 weeks and training runs ranged from 3 miles to a half-marathon (13.1 miles). Unloaded amounts decreased from 20 to 3 pounds. Training times improved at all distances and were maintained following resumption of normal training.

The spine is one of the most complex areas of the body. Injury to this region can lead to disabilities that could last a lifetime. The low back region of the spine includes the lumbar, sacral, and coccygeal spine.[5] The lumbar spine is composed of five vertebrae which provide the major support of the low back.[3] Intervertebral discs lie between the vertebrae and act as shock absorbers between each vertebrae.[4] The intervertebral disc is composed of layers of fibers called the annulus fibrosus and the center of the disc is filled with the nucleus pulposus.[1]

Back problems are common in sports and are most often the result of congenital, mechanical, or traumatic factors.[3] Low back pain can also be the result of chronic overuse stresses.[6] There is a high probability of recurrent and chronic low back pain in athletes.[4] Any movement that causes pressure on the disc may cause it to rupture or herniate through an area of a defective annulus.[11] An athlete who complains of low back pain that radiates into the lower extremities may have a herniated disc.[2] This pain will follow the nerve root distribution in the leg.[11] Treatment options for athletes with a herniated disc vary, and indications for surgery, and its effectiveness, are controversial.[7]

A spinal examination and structural evaluation is necessary to determine the cause of low back pain and a rehabilitation program may be developed.[8] Rest is a recommendation for some cases of acute and chronic back injury and pain. Months of training could be negatively affected by prolonged rest. The purpose of this report is to describe the care and treatment of a marathon runner affected by intervertebral disc herniation and the use of unloaded treadmill training therapy.

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CASE REPORT

A 36-year-old female marathon runner had a 6-month history of pain and stiffness in the lower back region. This pain radiated down her left posterior thigh following the route of the sciatic nerve. The pain originally began during a flexibility session while performing a hamstring stretch. She continued to train for a national championship, but began to have increasing pain and discomfort during both running and rest. The athlete qualified for and competed in the national championship marathon. She stated that during the race she lost the feeling in her left foot at mile 15, but continued and completed the 26.2 mile race. It took 3 days for the feeling to return to the foot. She reduced her mileage and continued to train following the marathon. She still had pain in her back and hip, and pain radiating down into the calf area. Pain was present during sitting and running.

The athlete sought physician care 6 weeks postinjury. Physical examination at the initial physician visit revealed tenderness at the lumbosacral junction and some tenderness at the left sciatic notch. Increased lumbar lordosis was also noted. She had mild restriction of motion and no lists or spasm. Her neurological examination was normal. A straight leg raising test was positive on the left leg at 60° and negative on the right leg. Radiological examination of the lumbosacral area showed an increased lumbar lordosis, but otherwise looked normal. The physician suspected that the athlete's problem was related to a lumbar disc injury. A lumbar MRI was scheduled to continue the evaluation, and upon completion and review, showed that there was indeed a herniation of the disc between L-4 and L-5. There was nerve root compression at this level. The physician decided that surgical intervention would not be necessary at this time.

The athlete completed a daily rehabilitation program developed to strengthen the muscles of the spine, hip, and abdomen. Exercises included trunk flexion and extension, hip flexion and extension, and abduction and adduction. Positions of exercises included standing, prone, and supine. Proper flexibility of the spine, hip flexors, and hamstrings were also emphasized with care taken not to aggravate the injury. The athlete completed 3

sets of 10 repetitions of each exercise daily. She stopped any exercise which caused an increase in pain or caused pain to radiate. Electrical muscle stimulation and moist heat therapies were applied daily for 20-minute periods to decrease muscle spasm and pain. Running was restricted and nonweight-bearing activities were recommended for maintenance of conditioning. Activities discussed with the athlete as alternatives to running included the use of a stationary bike, stair stepper, and swimming or deep water running. Noncompliance was a problem with this athlete. None of these activities offered her a suitable substitute for running.

After some discussion among the physician, physical therapist, and athletic trainer, the use of a highly specialized piece of equipment called the ZUNI Incremental Weightbearing System was used (SOMA, Inc, Austin, TX). Unloaded treadmill training therapy was then attempted to allow this athlete to continue to train. Unloading was developed by DD Kelsey, PT, in 1986 and is defined as the process of mechanically reducing the gravitational force on the spine by a specified amount. This process allowed the athlete to exercise at less than full body weight and to reduce the amount of stress on the joints and tissue, which allowed her to train for longer periods of time pain-free.

Preparation of the athlete for training included selecting a harness that allowed freedom of movement to run and that was secure enough to prevent any shifting during the session (Fig 1). The athlete stood on a treadmill under the Incremental Weightbearing System, and the harness was connected to a cable and T-bar (Fig 2). The slack was removed from the cable and the athlete began to run on the treadmill (Fig 3). She was unloaded at each session to the point that she could run pain-free. Unloading was accomplished by pushing a button that increased the lifting force on the harness until there was no pain. The controls could be adjusted in 1-lb increments at any time during the session without interrupting the exercise.

The athlete trained twice a week for 16 weeks for a total of 32 sessions. Unloaded training runs on the treadmill ranged from 3 miles to a half-marathon (13.1 miles). Interval and hill training sessions were simulated by variance of speed and elevation of the treadmill. We recorded total time and mile splits for each training session (Table 1). Pain and fatigue were recorded daily and adjustments in amounts unloaded were made as needed. The athlete trained in her own comfort zone. The amount of unloading decreased from 20 pounds initially in the program to 3 pounds at the conclusion. Training times improved at all distances and have been maintained following release to standard training (Table 2). After a brief familiarization period, the athlete became comfortable with its opera-

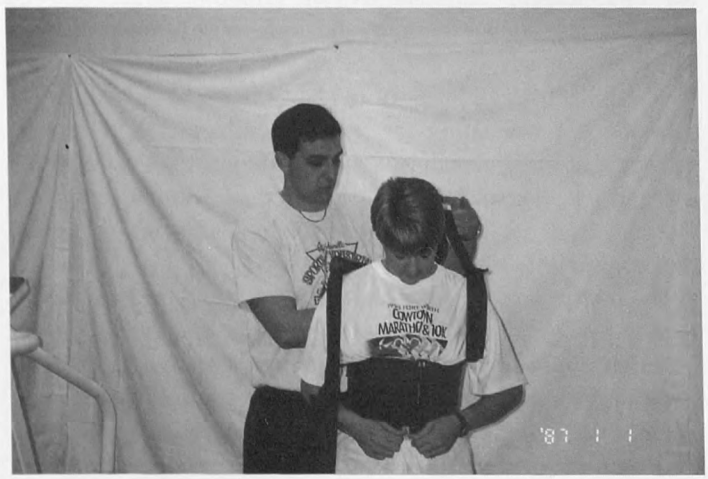

Fig 1. Harness application.

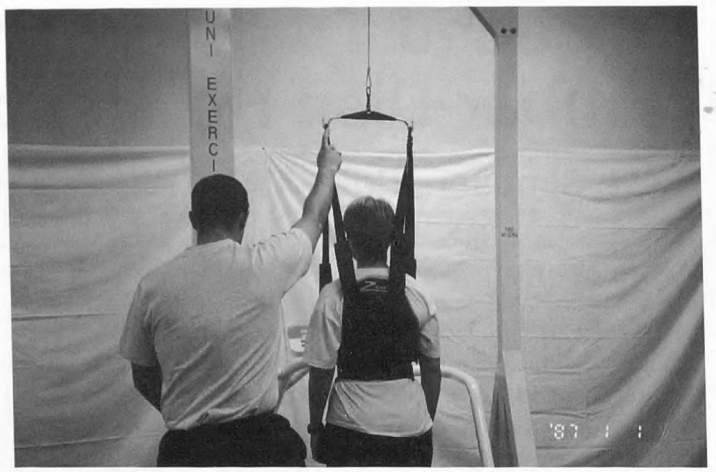

Fig 2. Athlete and harness to the system.

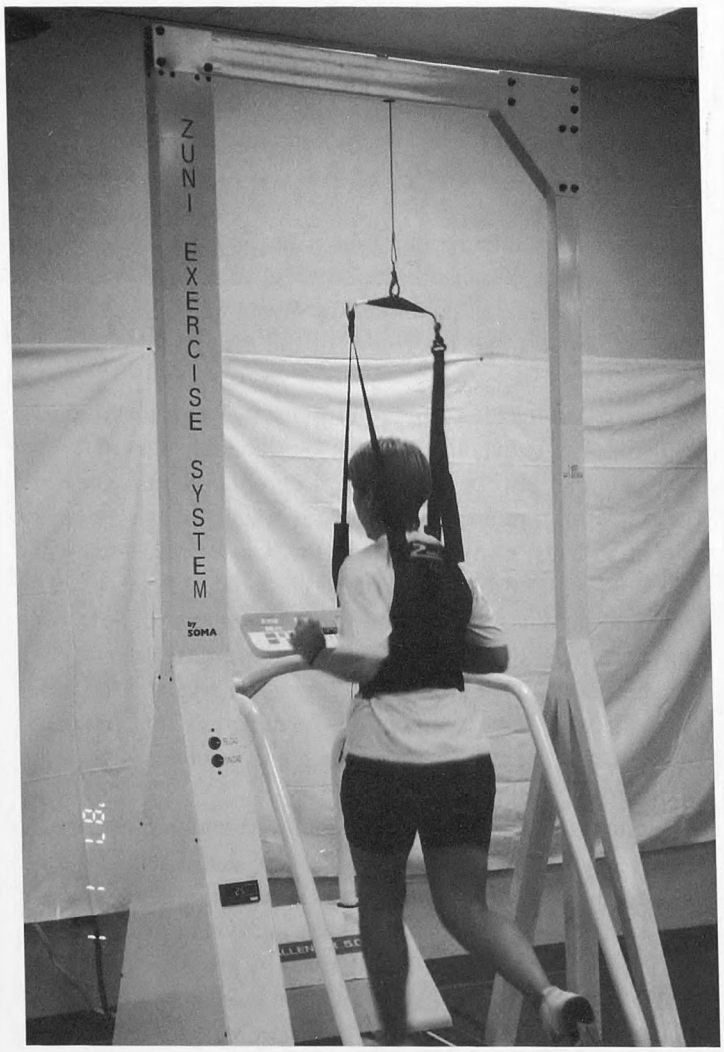

Fig 3. Athlete training on treadmill while unloaded.

Table 1. Average Training Run Times (Mile Splits/Total Times)

	Training distance			
Mile	3 miles	5 miles	7 miles	13.1 miles
1	6:32	6:50	6:56	7:04
2	12:58	13:38	13:47	14:03
3	19:14	20:26	20:37	21:02
4		27:14	27:27	28:02
5		33:27	34:17	35:00
6			41:07	41:58
7			47:34	48:56
8				55:53
9				62:49
10				69:45
11				76:41
12				83:30
13				90:28
Total time	19:14	33:27	47:34	1:30:28

Table 2. Training and Previous Best Comparison (Average Pace and Total Times)

	Training distance			
	3 miles	5 miles	7 miles	13.1 miles
Average pace per mile (after injury)	6:24	6:41	6:47	6:54
Previous average pace (before injury)	7:05	7:45	7:47	7:51
Total time (after injury)	19:14	33:27	47:34	1:30:28
Previous best (before injury)	21:15	38:45	54:30	1:43:00

tion and compliance was achieved. Modality treatments and exercise continued through the 16 weeks of training. The athlete continued to improve and completed the program of rehabilitation and conditioning without further incident.

DISCUSSION

The intervertebral disc most often injured lies between the fourth and fifth lumbar vertebrae. This is the same mechanism of injury as for a lumbosacral sprain.[5] This was the injury sustained by the marathon runner in this case report. The physician attributed the injury to structural abnormalities and repetitive trauma. Treatment options included limited activity, anti-inflammatory medication, rehabilitation, and gradual return to activity.[7] The unique aspect of the athlete's rehabilitation was the use of the Incremental Weightbearing System, which allowed her pain-free training while recovering from the injury. The unit is a free-standing and adjustable weight-bearing control device which can be used in conjunction with treadmill training. This therapeutic equipment allows controlled reduction of body weight during exercise.[14] The athlete gradually progressed from decreased weight bearing to full body weight running. This training technique allowed specificity of training. Alternative training programs using a bike or stair stepper would have aided general fitness and conditioning, but would not improve or maintain her running capacities. Also, the athlete would not comply with these activities. The athlete's rehabilitation program was adapted to provide the specific stresses imposed by her sport.

Another goal of rehabilitation was to promote tissue healing and to improve strength, flexibility, and endurance. Pain was a factor that prevented the athlete from completing the activities needed to allow this to occur. The Incremental Weightbearing System produced an effect that reduced stress on injured joints and tissue.[14] We believe the unloaded therapy technique enabled stress to be reduced on that tissue and allowed an early return to functional exercise using normal gait patterns. The tissue capacity for stress was returned by gradually reducing unloading to the lumbar spine.

There have been few studies completed on the effects of unloaded therapy. Investigators have studied the effects of this unloaded procedure on the biomechanical analysis of gait rehabilitation. Finch et al[9] showed a reduction in electrical activity of muscles used during the stance phase of gait. Increased motor activity of the anterior tibialis and a raised center of gravity during unloaded treadmill exercise was also noted.[9] Pillar et al[12] reported a significant increase in gait symmetry and velocity by unloaded therapy and noted that subjects were able to use a more normal gait during exercise.[12]

A primary goal of this program was to allow this athlete to continue to train during the healing process. An unexpected effect of the unloaded treadmill training was an increase in the athlete's running speed, resulting in a decrease in overall training time. Due to the unloading, there was an increase in speed of all training sessions compared to regular training sessions. It did not make a difference whether the session was a 3-mile speed run or a half-marathon endurance run.

Reductions in heart rate, oxygen cost, and caloric expenditure of walking with unloaded treadmill exercise have been consistent with those of water exercise due to the buoyancy effects of both modes of training.[10] In addition, heart rate and oxygen consumption are less during unloaded treadmill walking than during normal-weight bearing walking.[10] We believe that the unloaded treadmill training enabled this athlete to continue to train through injury, and with the lower energy consumption, allowed her to train at increased speed. Upon return to full weight-bearing running, this marathon runner has continued to maintain her increased pace. She achieved compliance because she was able to continue her preferred activity. Unloaded treadmill training therapy seems to have potential in the training of runners who require partial reduction in weight bearing in order to continue running.

Chronic low back pain and disability can disrupt an athlete's training and daily activities. It can become associated with emotional distress, depression, and failed treatment. This condition can progressively evolve to one that is resistant to traditional medical management.[13] In the case report presented, by using a nontraditional training approach, this runner met the ultimate goal for rehabilitation of a healthy return to athletic competition. There may be significant implications for the use of unloaded treadmill training therapy in the management of injuries to athletes. This could be of value when a reduction in weight bearing is indicated. Further study is warranted to determine effective use of this therapy.

REFERENCES

1. American Academy of Orthopaedic Surgeons. *Athletic Training and Sports Medicine.* 2nd ed. Rosemont, IL: American Academy of Orthopaedic Surgeons; 1991:514.
2. American Academy of Orthopaedic Surgeons. *Athletic Training and Sports Medicine.* 1st ed. Park Ridge, IL: American Academy of Orthopaedic Surgeons; 1986:409.
3. Arnheim DD. *Essentials of Athletic Training.* 3rd ed. St Louis, MO: Mosby-Year Book; 1995:407, 424.
4. Arnheim DD. *Modern Principles of Athletic Training.* 7th ed. St Louis, MO: Times Mirror/Mosby College Publishing; 1989;663, 675–676.
5. Arnheim DD, Prentice WE. *Principles of Athletic Training.* 8th ed. St Louis, MO: Mosby-Year Book; 1993:633–634, 666.
6. Booher JM, Thibodeau GA. *Athletic Injury Assessment.* 3rd ed. St Louis, MO: Mosby-Year Book; 1994:327.
7. Davis AD, Carragee EJ. Sciatica: treating a painful symptom. *Phys Sportsmed.* Jan 1992;20:126–137.
8. Fahey TD. *Athletic Training Principles and Practice.* Palo Alto, CA: Mayfield; 1986:259,263.
9. Finch L, Barbeau H, Arsenault B. Influence of body weight support on normal human gait: development of a gait retraining strategy. *Phys Ther.* 1991;71:842–856.
10. Murray JM, Hunter DL, Pape MW, Kelsey DD, Murray TD. Determination of the physiological effects of unloaded treadmill exercise. *Cardiopulmon Phys Ther J.* 1993;4:13–16.
11. O'Donoghue DH. *Treatment of Injuries to Athletes.* 3rd ed. Philadelphia, PA: WB Saunders; 1976:469–470.
12. Pillar T, Dickstein R, Smolinski Z. Walking reeducation with partial relief of body weight in rehabilitation of patients with locomotor disabilities. *J Rehab Res Dev.* 1991;28:47–52.
13. Prentice WE. *Rehabilitation Techniques in Sports Medicine.* 2nd ed. St Louis, MO: Mosby-Year Book; 1994:195, 278.
14. Zuni Exercise System/Unloading Exercise Therapy Austin, TX: SOMA Products; 1991.

Bilateral Foot Pain in a Collegiate Distance Runner

Craig R. Denegar, PhD, ATC, PT; Bonnie J. Siple, MS, ATC

ABSTRACT: A 19-year-old, white female, college freshman cross-country runner presented to the athletic training center complaining of bilateral plantar foot pain 1 week into the cross-country season. She had been treated for bilateral plantar fasciitis twice in the previous 3 years, and initial evaluation suggested a recurrence. A failure to respond to treatment led us to suspect other causes. Subsequent diagnostic imaging (bone scan, CT scan) revealed bilateral navicular stress fractures. Navicular stress fractures are probably more common than once believed. This case study describes the course of evaluation and treatment in relation to the common presentation, etiology, problems of diagnosis, and treatment of navicular stress fractures.

The recognition and treatment of stress fractures of the tarsal navicular in running athletes have been described in the medical literature.[3,5,7–11,14–15,17–19] However, navicular stress fractures are apparent on plain x-ray in a relatively small percentage of cases and, therefore, may go unrecognized.[3,7,8,11,16,17,19] Thus, the incidence of this stress fracture may be higher than has been reported.[5,11] The purposes of this case study are to: 1) describe a set of symptoms that led us to suspect foot pain which was not due to plantar fasciitis, 2) present a case of bilateral tarsal stress fractures, and 3) heighten awareness of these difficult-to-diagnose fractures.

THE INJURY

A 19-year-old, white, female, college freshman cross-country runner came to the athletic training center complaining of bilateral plantar foot pain 1 week into the cross-country season. Before the onset of pain, she was running 40 miles per week in preparation for the college cross-country season. She had been running cross-country since the age of 13 and had competed in indoor and outdoor track throughout high school. She reported two previous episodes of bilateral foot pain. The first occurred during a running camp 3 years before her presenting to us. At that time, she was diagnosed as having bilateral plantar fasciitis. She stated that she was referred to a podiatrist and that x-rays were negative. Orthotics were prescribed, and the foot pain resolved in 1 month.

The second episode of bilateral foot pain occurred 1 year before presenting to us while she was preparing for the cross-country season. She was again treated by a podiatrist with orthotics, an oral anti-inflammatory, and ultrasound two to three times per week. No x-rays were taken. She missed the entire cross-country season, but was able to compete in indoor and outdoor track.

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Her chief complaint was bilateral plantar pain during and after running and walking. The pain extended from the calcaneus to the head of the first metatarsal. No swelling, discoloration, or deformity was present. She was observed to hyperpronate bilaterally. Palpation revealed tenderness near the insertion of the Achilles tendon and along the medial plantar arch, including the area of the talonavicular joint.

Initially, she was diagnosed as suffering from, and treated for, plantar fasciitis. Treatment consisted of nonsteroidal anti-inflammatory medication, phonophoresis, transverse friction massage, and conventional stretching and strengthening exercises. Night splinting was added to the treatment regimen. Due to a failure to respond to treatment, x-rays were ordered. The x-rays were viewed as negative (Figs 1 and 2). A second medical opinion was sought because the pain extended posterior to the origin of the plantar fascia on the calcaneus and because she reported pain during and after workouts, but not upon rising in the morning. Three possible diagnoses emerged: bilateral tarsal tunnel syndrome, navicular stress fractures, and insertional posterior tibial tendinitis.

Nerve conduction velocity studies of the tibial nerve distributions were normal. Subsequent radionuclide bone scans revealed an increased uptake over the navicular bilaterally (Fig 3). Computerized tomography (CT) of the right navicular reinforced suspicion of a stress fracture (Fig 4). There was no transcortical defect present on CT; however, mild cortical sclerosis was evident. The patient was more symptomatic on the right. Therefore, she was treated with touch-down weight bearing in a walking cast on the right leg and instructed to use axillary crutches. CT of the left foot was deferred.

Following 6 weeks of crutch-assisted touch-down weight bearing, the point tenderness over both naviculae was completely resolved. Gradual weight bearing with accompanying foot/ankle rehabilitation, including manual and flexible tubing-resisted movements were prescribed. At the end of 6 weeks, reconditioning of the lower extremity had progressed sufficiently. She was fitted with a new pair of semirigid orthotics, and a return-to-running program was initiated. The return-to-running program progressed without symptoms of stress fracture, but was hampered when the athlete developed tendinitis

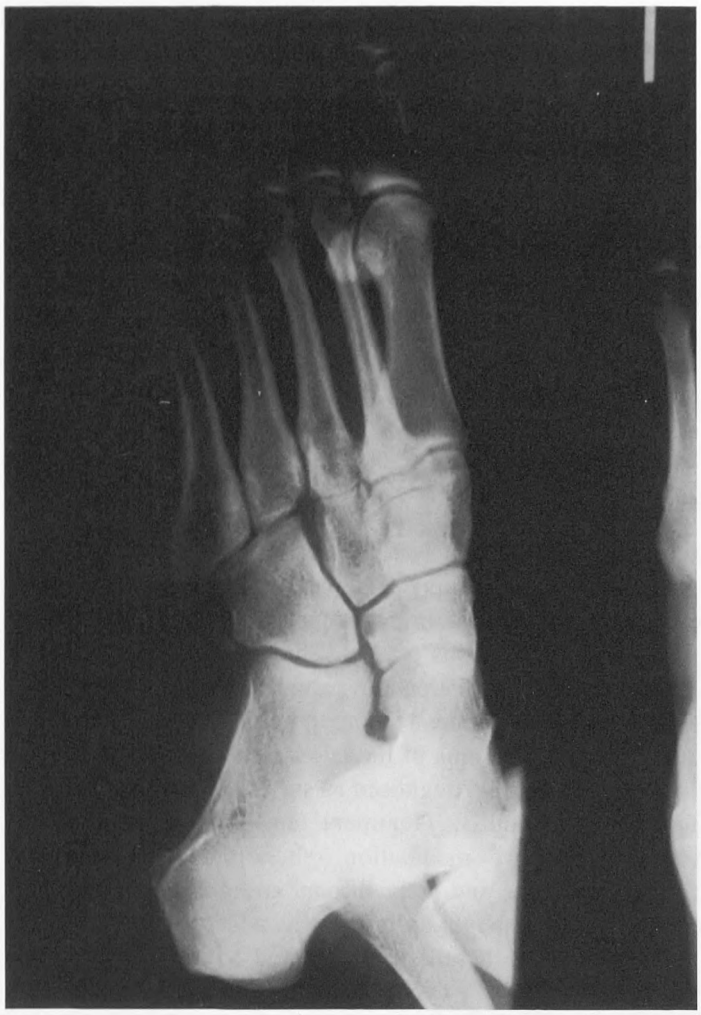

Fig 1. X-ray of left foot.

Fig 2. X-ray of right foot.

of the right extensor hallucis. The tendinitis was resolved and the return-to-running resumed.

DISCUSSION

Stress fractures of the navicular present a challenge for members of the sports medicine team. The onset of pain is usually insidious[11,19] and may be poorly defined. As in this case, confirmation of a diagnosis may be delayed as other more common pathologies are ruled out. Irritation of the medial plantar and posterior tibial nerves may cause radiating pain throughout the medial plantar aspect of the foot. Symptoms may mimic other foot pathologies such as plantar fasciitis, tarsal tunnel syndrome, tendinitis, Morton's neuroma, and metatarsalgia.[10,11]

Tenderness over the proximal dorsal portion of the navicular, described by Torg et al,[19] and termed the "N spot,"[10] should raise the suspicion of navicular stress fracture. The clinician should also suspect stress fracture when the pattern of pain deviates from the typical complaint of morning pain associated with plantar fasciitis. The pain associated with navicular stress fracture generally occurs or increases during and after running.[1,9,11]

The presentation of the subject in this case study was consistent with previous reports. The onset of pain was insidious. There was tenderness over the proximal dorsal navicular and the pain radiated along the longitudinal arch of the foot. The lack of discoloration and swelling were also consistent with clinical findings in previous cases.[17,19] However, it was the lack of pain upon rising and increased pain with running that led us to suspect a cause other than plantar fasciitis.

As in this case, plain x-ray films often fail to identify navicular stress fractures. Kahn et al[11] reviewed several studies incorporating 128 cases of navicular stress fractures and reported that plain x-rays provided false-negative results in 86 cases. One possible cause for the failure of x-ray to identify stress fracture is improper positioning of the foot. Supination of the foot to 20° and elevation of the medial foot is suggested in order to place the navicular perpendicular to the x-ray and properly expose the dorsal surface.[10,17] Despite optimal positioning, it is difficult to detect stress fractures in the early stage with plain x-ray.[4,6,11,13,16,19]

Because of the high rate of false-negative results from plain films, radionuclide bone scan is recommended as a more sensitive test.[3,5,7,11,16,17] Although more sensitive than plain x-rays, bone scans are less specific.[16] CT and magnetic resonance imaging are cited in the literature as aiding in the diagnosis of tarsal navicular stress fractures.[11,12,17] However, CT permits the differentiation of stress fractures from other

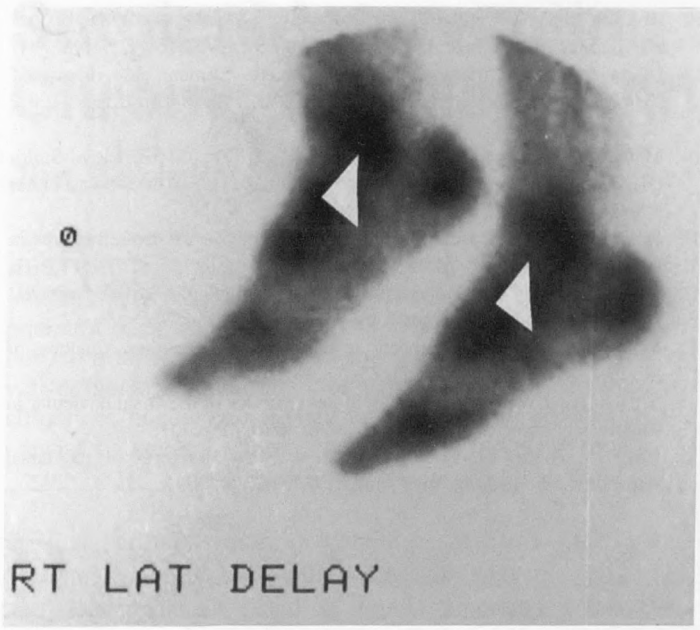

Fig 3. Radionuclide bone scans demonstrating increased uptake over the tarsal naviculae.

Fig 4. Computerized Tomography (CT) of the right navicular demonstrating cortical sclerosis.

sources of increased bone metabolism[11,12,16] and identifies fracture displacement or nonunions.

Nonweight-bearing cast immobilization is recommended in cases of partial and nondisplaced complete navicular stress fractures.[3,7,10,11,19] Complete fractures with displacement require open reduction with internal fixation, while a bone graft may be necessary in cases of nonunion.[19] Because of the bilateral fractures in this case, the athlete was treated with touch-down weight bearing in a walking cast on the most tender foot. Fortunately, the decrease in activity and the compliance with the use of axillary crutches resulted in the alleviation of symptoms bilaterally. Limitation of weight-bearing activity without cast immobilization results in a higher rate of treatment failure than cast immobilization for 6 weeks.[11]

A program of rehabilitation with gradual increases in weight-bearing activity may be initiated when the tenderness over the "N spot" resolves. Bone scans and CT are generally not useful in determining if increased weight bearing can be initiated, because the former may remain positive long after clinical union, while the latter will not demonstrate complete obliteration of the fracture line despite the complete resolution of symptoms.[10]

Prolonged healing and nonunion are common complications of delayed diagnosis.[15] In this case, nearly 2 months elapsed between the onset of symptoms and diagnosis. Others have reported much longer delays.[8,19]

Navicular stress fractures have been reported in a variety of athletes but are usually associated with running and jumping activities. Ting et al[18] did not identify any anatomical variations in athletes with navicular stress fractures. However, excessive pronation and increased pronation velocity may be contributing factors.[14,18]

The female triad has been implicated as a cause of stress fractures. The medical history of female athletes who suffer stress fractures should be reviewed to identify women who are predisposed to stress fractures and other complications secondary to eating disorders, amenorrhea, and osteoporosis.[1,2,13]

Stress fractures of the tarsal navicular are uncommon. Our review of the literature found only five cases of bilateral fractures reported previously.[11] However, athletic trainers and other members of the sports medicine team should be suspicious of navicular stress fracture when plantar pain fails to respond to other treatments, when there is tenderness over the proximal dorsal navicular, and when pain is increased during and after running activity. As in this case, bone scan and CT are often necessary to establish the diagnosis. Most navicular stress fractures can be treated successfully with 6 weeks of nonweight-bearing cast immobilization. The prognosis for return to athletic competition is good.

REFERENCES

1. Burke L. Amenorrhea, low bone density and stress fractures in athletes. What is the dietary connection? Part one: sports amenorrhea. *Sport Health.* 1990;8:44, 47.
2. Cameron KR, Wark JD, Telford RD. Review: stress fracture and bone loss—the skeletal cost of intense athleticism. *Excel.* 1992;8:39–55.
3. Davis AW, Alexander IJ. Problematic fractures and dislocations in the foot and ankle of athletes. *Clin Sports Med.* 1990;9:163–182.

4. Fitch KD, Blackwell JB, Gilmour WN. Operation for non-union of stress fracture of the tarsal navicular. *J Bone Joint Surg [Br].* 1989;71B:105–110.
5. Goergen TG, Venn-Watson EA, Rossman DJ, Resnick D, Gerber KH. Tarsal navicular stress fractures in runners. *Am J Radiol.* 1981;136:201–203.
6. Gordon TG, Solar J. Tarsal navicular stress fracture. *J Am Podiatr Med Assoc.* 1985;75:363–366.
7. Hershman EB, Mailly T. Stress fractures. *Clin Sports Med.* 1990;9:183–214.
8. Hulkko A, Orava S, Peltokallio P, Tulikouro I, Walden M. Stress fracture of the navicular bone: nine cases in athletes. *Acta Orthop Scand.* 1985;56:503–505.
9. Hunter LY. Stress fracture of the tarsal navicular. More frequent than we realize? *Am J Sports Med.* 1981;9:217–219.
10. Khan KM, Brukner PD, Kearney C, Fuller PJ, Bradshaw CJ, Kiss ZS. Tarsal navicular stress fracture in athletes. *Sports Med.* 1994;17:65–76.
11. Khan KM, Fuller PJ, Brukner PD, Kearney C, Burry HC. Outcome of conservative and surgical management of navicular stress fracture in athletes. Eighty-six cases proven with computerized tomography. *Am J Sports Med.* 1992;20:657–666.
12. Kiss ZS, Khan KM, Fuller PJ. Stress fractures of the tarsal navicular bone: CT findings in 55 cases. *AJR Am J Roentgenol.* 1993;160:111–115.
13. Licata AA. Stress fractures in young athletic women: case reports of unsuspected cortisol-induced osteoporosis. *Med Sci Sports Exerc.* 1992; 24:955–957.
14. Matheson GO, Clement DB, McKenzie DC, Taunton JE, Lloyd-Smith DR, MacIntyre JG. Stress fractures in athletes: a study of 320 cases. *Am J Sports Med.* 1987;15:46–57.
15. Orava S, Hulkko A. Delayed unions and nonunions of stress fractures in athletes. *Am J Sports Med.* 1988;16:378–382.
16. Pavlov H, Torg JS, Freiberger RH. Tarsal navicular stress fractures: radiological evaluation. *Radiology.* 1983;148:641–645.
17. Santi M, Sartoris DJ. Diagnostic imaging approach to stress fractures of the foot. *J Foot Surg.* 1991;30:85–97.
18. Ting A, King W, Yocum L, et al. Stress fractures of the tarsal navicular in long-distance runners. *Clin Sports Med.* 1988;7:89–101.
19. Torg JS, Pavlov H, Cooley LH, et al. Stress fractures of the tarsal navicular. *J Bone Joint Surg [Am].* 1982;64A:700–712.

Surgical Intervention and Rehabilitation of Chronic Patellar Tendinitis

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ABSTRACT: Patellar tendinitis is a common overuse injury that affects many basketball players. The key to successful management of patellar tendinitis is prevention and early intervention. In a small percentage of the athletic population, conservative management does not yield satisfactory results and surgery is necessary. Rehabilitation following surgery should consist of several stages, including: 1) range of motion, 2) strengthening, 3) flexibility, 4) sports-specific exercises, 5) cardiovascular conditioning, and 6) gradual return to play. Although there are many documented rehabilitation guidelines for conservative management of tendinitis, there are few for the surgical management of patellar tendinitis without complete rupture. More research is needed regarding postsurgical management.

Patellar tendinitis is a common overuse injury that affects many volleyball and basketball players.[1] In 1973, Blazina et al[5] listed its signs, symptoms, and various stages. These stages have been classified, based on the activity-related symptom and the level of functional impairment: stage 1—pain after activity only, no functional impairment; stage 2—pain at the beginning of the activity, disappearing after warm-up, and recurring after activity; stage 3—pain during and after activity that impairs function; and stage 4—complete rupture. There is no predilection, although it is most common in skeletally mature individuals. Tenderness is usually localized to the patellar tendon insertion at the inferior pole of the patella, along the course of the patellar tendon, or to the tibial tubercle.[4]

No specific correlation exists between the pathoanatomy and the symptomatology in the patellar tendon injury secondary to overuse. It is obvious that not all cases of stage 3 patellar tendinitis have the same pathologic features. One characteristic, however, appears to be consistent: the pathology usually involves areas of degenerative and necrotic tissue, which may or may not involve partial rupture of the patellar tendon.

Although there is much literature regarding the conservative management of tendinitis, there appears to be little in the area of rehabilitation following a surgical case of patellar tendinitis without a complete rupture. Following is a case study of stage 3 patellar tendinitis in a collegiate basketball player and the ensuing rehabilitation protocol.

THE PATIENT

A 6-ft, 10-inch, 240-lb, 22-year-old, Caucasian, male, Division I basketball player complained of a dull, sore, achy sensation in the patellar tendon region of the left knee approximately 2 months into the official basketball season. The pain was more intense following activity, although it did not affect his level of play. Conservative treatment was initiated. After 14 days of conservative treatment without satisfactory results, an orthopedist evaluated the athlete and made a diagnosis of unilateral patellar tendinitis. Routine radiographs revealed no significant findings. The patient had no prior history of patellar tendinitis. There were no known underlying pathological conditions that contributed to the advancement of the condition. The physician prescribed continued conservative treatments consisting of phonopheresis, moist heat, rest, interferential stimulation, cross-friction massage, Cho-Pat strap (Cho-Pat Inc, Hainesport, NJ), anti-inflammatory medications, and ice. These treatments were administered with varying degrees of success. Four months of continued conservative treatments yielded minimal results and a surgical option was recommended.

The surgical procedure consisted of examination under anesthesia, a diagnostic arthroscopy, followed by a surgical procedure for the tendon. The diagnostic arthroscopy was negative, with no abnormalities noted. The surgical procedure for the patellar tendon has been described by Karlsson et al.[2] The surgical technique involved longitudinally splitting the paratenon and identifying the abnormal area in the patellar tendon. Radial resection of the devitalized tissue was carried out to normal tissue margins. The defect in the patellar tendon was then closed with absorbable sutures.[4] Pathology results from the surgery confirmed chronic inflammation of the involved tissue. The patient was then placed in a straight-leg immobilizer postoperatively, and rehabilitation began the day following surgery.

REHABILITATION

Early Phase

The first 7 days following surgery were spent in total immobilization. The athlete worked on straight-leg raises in hip flexion, extension, abduction, and adduction while in the brace. Plantar flexion and dorsiflexion exercises were done with elastic tubing. Patellar mobilization exercises were also done in all directions. Cardiovascular endurance was maintained with the use of an upper body cycle. The exercises were performed in three sets of 15 repetitions, three times a day. During the second week, the patient's brace was opened to allow 0° to 45° of active flexion. Isometric contractions were also performed within the limits of the range of motion, in

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addition to the previous exercises (Fig 1). During the third week, the brace was opened from 0° to 90° of active flexion. Concentric contractions were also initiated within the range of motion. Straight-leg raises were done with light weights (5 lb). All exercises were pain-free. Cryotherapy treatments followed each rehabilitation session.

Goals of the early phase included several tasks. Regaining the normal range of motion pain-free was the most important goal. Other goals included pain-free use of the extension mechanism through the use of straight-leg raises in hip extension and maintaining the level of cardiovascular endurance.

Intermediate Phase

The intermediate phase (weeks 4 through 6) of the rehabilitation protocol was characterized by the beginning of the eccentric contractions and weight-bearing exercises. The use of a postoperative brace during weight bearing was discontinued, and partial weight bearing was begun through the use of hydrotherapy. The athlete began nonweight-bearing activities such as bicycling, jogging, and cross-country skiing motions in the deep end of a pool. Partial weight-bearing exercises were done in the shallow end. These exercises consisted of jogging, plyometrics, and sports-specific exercises. The exercises were done in the shallow end due to the effects of buoyancy on the body and the reduction of the stress on the extensor mechanism. The patient worked from shoulder-deep water gradually toward waist-deep water, thus increasing the weight-bearing capacity of the extensor mechanism in a controlled environment. These exercises must also be performed pain-free and consist of multiple repetitions. Eccentric contractions were also begun during this phase of the rehabilitation (Fig 2). Light eccentric contractions were done at low speeds (50°/sec or less), and cardiovascular endurance was incorporated into the pool exercises.

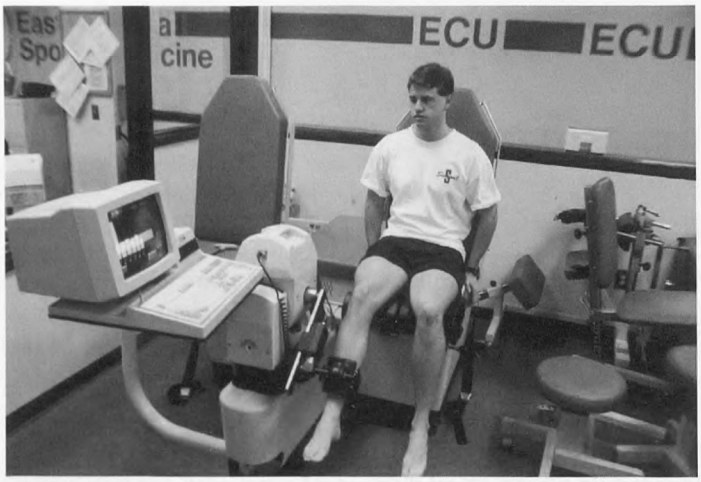

Fig 1. Isometric contractions were performed on the Kin-Com 500H System (Chattecx Corporation, Chattanooga, TN), which provides a continuous feedback loop during the training. This system also trains eccentrically which is essential during the advanced phase of the rehabilitation process.

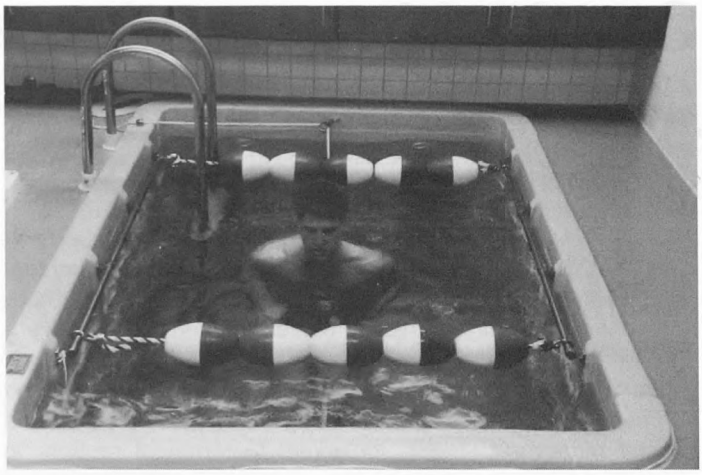

Fig 2. The aqua therapy was performed in an Aqua Ark (Therapeutic Systems, Inc, Doylestown, PA). The 8-foot-deep tank is excellent for nonweight-bearing activities and conditioning. The athlete is tethered to the tank and is suspended without the athlete's assistance.

The main goal of this phase of the rehabilitation is to prepare the body and the extensor mechanism for full weight bearing while remaining pain-free.

Advanced Phase

The advanced phase (weeks 7 through 10) was characterized by the incorporation of full-weight-bearing exercises and increased use of eccentric contractions. The eccentric contractions were done with increased weight and at higher speeds. Full-weight-bearing plyometrics were done with small increases in the height and number of the repetitions. Some low-to-medium intensity sports-specific exercises were done, including: blocking out, rebounding, lay-ups, and jump shots. All of these exercises must also be pain-free. The exercises in this phase were executed for at least 1 week at each graduated interval starting with every other day; two days of exercise, one off; then every day. Once the exercises were tolerated every day, the intensity was slowly increased.

The goal of this phase of the rehabilitation is to gradually return the patient to preparticipation status. Careful attention is given to the ability level of the patient in the sports-specific drills and to possible symptoms that may arise from them. The number of repetitions should be noted and increased gradually.

Criteria for Advancement

Each phase and exercise must be pain-free (eg, for the patellar tendon). Exercises must include at least 20 repetitions at the current level for advancement. Modalities should not be used to mask symptoms, but are useful in the preventive sense.

Return to Sport

The return to sport should be done gradually. This would include working into controlled practice drills at gradually increasing levels of intensity, with the goal of game situation play as the end result.

The athlete began his return to full activity by gradually increasing the number of drills and repetitions of general sports-specific drills (ie, lay-ups, jump shots, free throws, etc). Following 2 weeks of drill work, he began to participate in pick-up games. The games were short in duration (less than 10 minutes) and were increased in frequency. The athlete was also placed on an oral anti-inflammatory medication to minimize symptoms during the return to participation.

The athlete still experienced residual soreness in the patellar tendon region throughout the rehabilitation process, but at a level that was felt to be tolerable to the athlete and significantly less than before the surgical intervention. The athlete actually reported that while playing in pick-up games, he felt less discomfort than when sitting in class. Treatments were reduced to the application of ice and pressure following activity for 30 minutes.

Preseason activities included weight lifting three times a week, aerobics twice a week, and pick-up games 5 days a week for 2 hours in a round robin format. The athlete now participates without restriction in all activities. Preventive treatments are still incorporated into the daily routine of the athlete.

DISCUSSION

The key to successful management of patellar tendinitis is prevention and early intervention. Because jumping is a highly specific activity requiring eccentric loads on the extensor mechanism, exercises must be geared toward simulating this condition. Although eccentric strengthening is ultimately required before a return to basketball, it is avoided until isometric and concentric contractions can be tolerated. The principles of specificity of training must be followed to effect adequate carryover to basketball.[3] Because basketball requires performance in all forms of contractions, each should be addressed in the patient's rehabilitation.

The safest environment for beginning jumping and other functional activities is in a pool. In the water, gravitational forces are minimized and this allows for excellent strengthening and conditioning to the extensor mechanism.[3] The injured player advanced to more land-based exercises and eventually to jumping.

The temptation to use a cortizone injection in the course of treatment in unresolved cases should be avoided. Studies have shown definite pathological changes in the tendon morphology as well as increased incidence of patellar tendon rupture.[3]

In this case, the rate of the protocol was intentionally at a slow pace as not to disturb the healing process, since the healing process was in question during the conservative phase of treatment.

CONCLUSION

Patellar tendon injuries during sports-related activities are most likely secondary to repetitive microtrauma to a failed healing response.[4] Every effort should be made to treat this injury with conservative management. Surgical treatment for patellar tendinitis should be viewed as a last resort following repeated attempts at conservative management. Although a vast amount of literature is present regarding the conservative management of tendinitis, there appears to be a deficiency of material in the area of rehabilitation following surgical cases of patellar tendinitis without a complete tendon rupture. Rehabilitation following surgery for patellar tendinitis needs further research to discover the most effective protocol for dealing with this injury. While this protocol worked quite effectively in this specific scenario, there may be a more effective protocol for healing and rehabilitating the surgical intervention of patellar tendinitis.

REFERENCES

1. Ferretti A, Ippoolito E, Mariani P, Puddu G. Jumper's knee. *Am J Sports Med.* 1983;11:58–62.
2. Karlsson J, Lundin O, Lossing IW, Peterson L. Partial rupture of the patellar ligament: results after operative treatment. *Am J Sports Med.* 1991;19:403–408.
3. Molnar TJ, Fox JM. Overuse injuries of the knee in basketball. *Clin Sports Med.* 1993;12:349–362.
4. Nichols C. Patellar tendon injuries. *Clin Sports Med.* 1992;11:807–813.
5. Tarsney F. Catastrophic jumper's knee: a case report. *Am J Sports Med.* 1981;9:60–61.

Conservative Treatment of Bilateral Sural Nerve Entrapment in an Ice Hockey Player

Brian J. Toy, PhD, ATC

ABSTRACT: Midway through the season, an intercollegiate ice hockey player experienced bilateral numbness in the posterior aspect of the leg along the area of the calcaneal tendon. This numbness corresponded with the distribution of both sural nerves. While obtaining a history of the condition, the athlete admitted that he routinely spiraled his ice hockey laces tightly around the proximal portion of each ice hockey boot before finally tying the laces off. A complete neurological examination was negative except for the bilateral numbness. Based upon this information, a diagnosis of bilateral sural nerve entrapment was made. In addition to frequent follow-up examinations, nonoperative treatment consisted of changing the way the athlete laced his ice hockey skates. The athlete was able to complete the season and, after approximately 4 months, was asymptomatic. Although this appears to be an isolated incident, athletic trainers should be cautious when evaluating patients with paraesthesia in this region. If symptoms such as those described develop, entrapment of the sural nerve should be considered as a possible cause.

Entrapment neuropathies occur to various large and small peripheral nerves of the body. Roles et al[9] reported on radial tunnel syndrome related to the entrapment of the radial nerve, while Learmonth et al[5] described entrapment of the median nerve in carpal tunnel syndrome. Entrapment of the tibial nerve in tarsal tunnel syndrome has also been described.[3,4]

Although it remains relatively free from injury,[6] isolated cases of sural nerve injuries and entrapment neuropathies have been reported. In 1972, Seddon[12] reported five cases of sural nerve injury caused by penetrating missile injuries. Of the two cases of isolated sural nerve neuropathy reported by Schuchmann,[10] one occurred to a soldier as a direct result of compression of the nerve from a combat boot, while the second case involved a nurse who experienced sural nerve stretch due to constant walking on an inverted foot. Pringle et al[8] reported four cases of entrapment of the sural nerve at the lateral side of the ankle and foot. In two of the subjects, the entrapment was attributed to ganglion development along the course of the nerve, while the third subject's condition was attributed to a thickened band of soft tissue which resulted from the patient's foot being run over by a truck a year earlier. Although no clear cause was attributed as the reason for the condition in the fourth subject, the authors concluded that the nerve was entrapped on the lateral side of the ankle by fibrous tissues.

Injury to the sural nerve resulting from athletic participation seems to be an uncommon event, because no cases of sural nerve injury resulting from such activity could be found in the English literature. However, due to its superficial anatomical location, this nerve may be vulnerable to injury in certain situations. Therefore, the purposes of this manuscript are to: 1) review the anatomy of the sural nerve; 2) alert the athletic trainer to the clinical signs and symptoms of sural nerve injury; and 3) present a case of sural nerve entrapment resulting from an athlete's participation in the sport of ice hockey.

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ANATOMY

The sural nerve is formed by the union of the medial sural cutaneous nerve and the peroneal communicating branch of the lateral sural cutaneous nerve (Fig 1, left). After arising from the popliteal fossa and passing distally between the two bellies of the gastrocnemius muscle, the medial sural cutaneous nerve is joined by the lateral sural cutaneous nerve's peroneal communicating branch at the midposterior calf to form the sural nerve. As it passes distally along the lateral margin of the calcaneal tendon, this cutaneous nerve gives branches to the posterior and lateral aspects of the distal third of the leg (Fig 1, right). After providing lateral calcaneal branches to the ankle and heel, the sural nerve passes behind the lateral malleolus. The nerve continues along the lateral side of the foot and extends to the fifth toe as the lateral dorsal cutaneous nerve.[2,7,8]

CASE REPORT

At midseason, a 5-ft, 11-inch, 185-lb, 22-year-old male intercollegiate ice hockey player reported to the team's athletic trainer complaining of bilateral numbness in the posterior aspect of the leg region along the area of the calcaneal tendon (Fig 2). At the initial evaluation, he reported noticing numbness during the previous 2 to 3 weeks. This numbness was most pronounced near the area of the lateral malleolus and occasionally extended to the dorsolateral aspect of each foot. No proximal or distal weakness, or proximal sensory deficits were reported. The athlete had no history of chronic low back problems or trauma to the lumbar region. No history of acute or chronic conditions to the popliteal fossa were reported. The athlete denied any history of trauma to either lower extremity and had been practicing and playing regularly. However, he did state that, in order to provide better support for his ankles, he routinely spiraled his ice hockey laces tightly around the proximal portion of each ice hockey boot before finally tying the laces off (Fig 3). To secure the laces, he then spiraled 1″ wide white athletic tape over the proximal portion of each ice hockey boot (Fig 4).

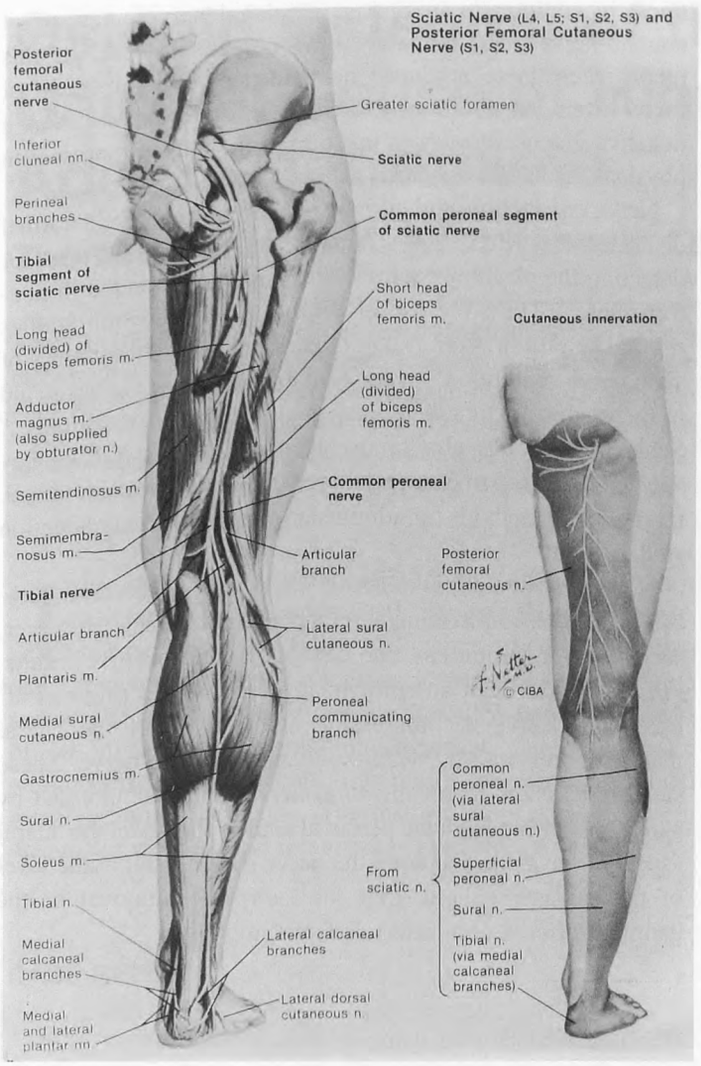

Fig 1. *Left* and *right*, anatomy of the sural nerve. (From: *Atlas of Human Anatomy* by Frank Netter, MD. Reproduced by courtesy of CIBA-GIEGY Limited, Basel (Switzerland). All rights reserved.

Initial examination revealed diminished pin prick sensation in the distribution of both sural nerves corresponding with dermatomes L5/S1. The most seriously affected areas were those located just superior to both lateral malleoli. Lower extremity strength tests for the ankle, intrinsic muscles of the feet, and all muscle groups proximal to the areas of insult were within normal limits. Calcaneal and patella tendon reflexes responded normally. Tinel's sign was negative and there was no local tenderness over the course of either nerve. Palpation of both popliteal fossae was unremarkable. Lumbar evaluation, including range of motion, strength, and bilateral straight-leg testing were all normal. Visual inspection of both lower extremities was unremarkable.

Due to a lack of neurological deficits other than sensory loss, in combination with a normal appearing popliteal fossa and a history of skate lace tightness, the diagnosis of bilateral sural nerve entrapment was made. Nonoperative treatment consisted of advising the athlete to change the way he laced his ice skates. The athletic trainer closely monitored the athlete for the remainder of the season, which the athlete was able to complete with no major complaints. During this time, the

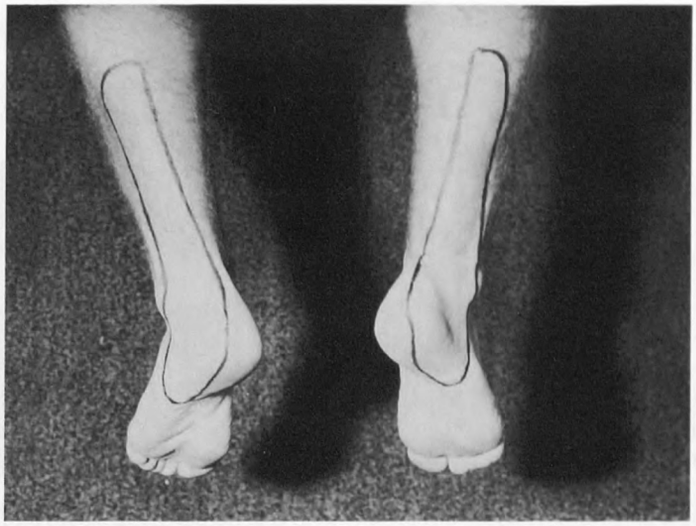

Fig 2. Areas of bilateral numbness in the posterior aspect of the leg along the area of the calcaneal tendon.

sensory deficits gradually subsided and, approximately 4 months from the time of onset, both extremities were asymptomatic.

DISCUSSION

Since the top of the normal ice hockey boot extends 2 to 4 cm above the tip of the lateral malleolus, a relationship between wearing the ice hockey skate with the laces and tape spiraled around the top of the boot and the development of sural nerve entrapment certainly appears to exist. This case mimics the findings of Schuchmann's[10] soldier patient who developed sural nerve neuropathy shortly after he began to wear combat boots. In that case, the patient's sural nerve returned to full function 7-1/2 months after he discontinued wearing the boots.

In addition to being vulnerable to injury as a result of direct trauma, irritation to the sural nerve may occur from fibrous adhesions that result from ankle injuries.[1,8] Thus, it would be wise for the athletic trainer to be aware of the clinical signs and

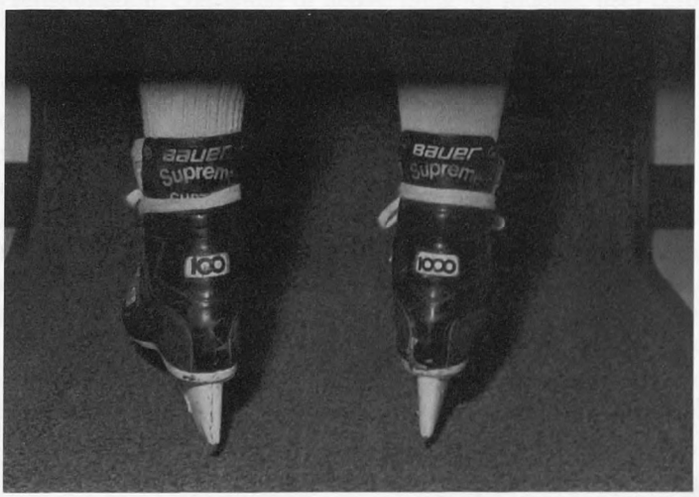

Fig 3. Ice hockey laces spiraled tightly around the proximal portion of each ice hockey boot.

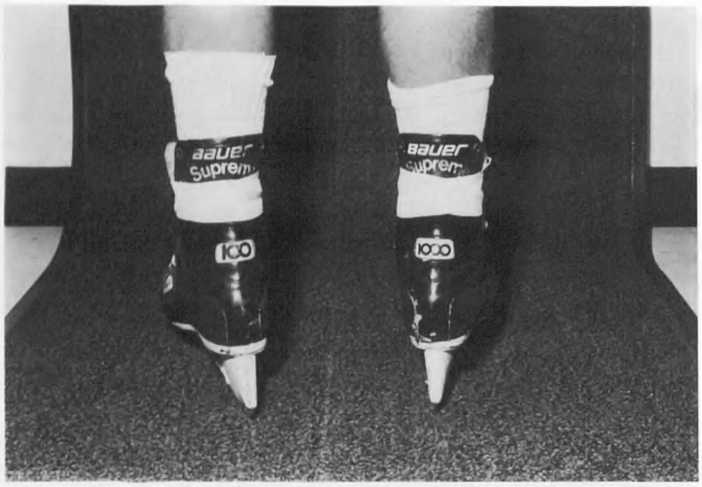

Fig 4. One-inch white athletic tape spiraled over the laces and around the proximal portion of each ice hockey boot.

symptoms exhibited by sural nerve involvement. Injury to the sural nerve may cause numbness in the affected area with decreased temperature sensation along the dorsolateral aspect of the foot.[10] A positive Tinel's sign, which may worsen while walking, may also provide evidence of injury to the sural nerve.[10] Additional indications of an abnormality may include a burning sensation, local tenderness over the sural nerve itself, and reproduction of the symptoms by gentle pressure on the nerve.[8]

Although these symptoms may indicate sural nerve involvement, the athletic trainer should also be well versed in recognizing and ruling out more serious conditions which may produce symptoms similar to sural nerve entrapment. A herniated L4/L5 nucleus pulposus, which can be confirmed through a computerized tomography (CT) scan, may produce similar symptoms. However, in response to disk herniation, motor deficits often occur in conjunction with sensory deficits. In the case presented, a CT scan was not initially performed because all clinical tests for motor dysfunction were within normal limits. In addition, the patient's paraesthesia complaints were bilateral and, although this would not rule out lumbar involvement, it made lumbar involvement more unlikely. However, sensory loss can occur before motor loss. Thus, an individual presenting with lower extremity sensory deficits should be monitored closely for the development of motor deficits.

Skate lace tightness could lead to the development of peripheral venous thrombosis in the calf region. In addition to causing paraesthesia in the area, clinical signs, including increased edema, engorged veins, and ecchymosis formation with a blue hue would be indications of this condition. This diagnosis was considered for the case in question; however, it was ruled out, based on the lack of clinical findings. Thus, a venogram, which would confirm a diagnosis of peripheral venous thrombosis, was not performed.

Peripheral sural nerve neuropathy related to diabetes may also be a cause of paraesthesia in this area. Diabetic neuropathies, in addition to involving peripheral nerves, can affect cranial nerves and the autonomic nervous system. In this report, the athlete produced no evidence of involvement at these levels. In addition, a lack of a family history and a negative glucose urinalysis test during the athlete's preseason physical made this diagnosis unlikely.

Nerve conduction studies, which determine a nerve's normal distal latency value,[10] offer some of the most useful tests for detecting the electophysiologic abnormalities founded in neuropathies.[1,6] Thus, the use of sural nerve conduction studies may be helpful in diagnosing or determining extent of injury of sural nerve conditions.[6] In addition to using these studies to aid in the diagnosis, treatment, and monitoring of two patients,[10] Schuchmann[11] has also reported normal sural nerve latency values. This report, among others, describes standardized, reproducible methods for administering sural nerve conduction studies.[1,6,11]

Nonoperative courses of treatment, as used in this case, have been successful in treating sural nerve conditions.[10] However, surgical intervention has also been used with positive results. For the treatment of an entrapment neuropathy, Pringle et al[8] used sural nerve decompression at the level of the lateral malleolus followed by wide mobilization of the nerve. These same researchers report the sural nerve being compressed by ganglions arising from the peroneal tendon sheath on the lateral aspect of the ankle and from the nerve sheath itself at the level of the calcaneo-cuboid joint. In each case, removal of the ganglion offered complete relief of symptoms.[8]

REFERENCES

1. Burke D, Nevell SF, Lethlean AK. Sensory conduction of the sural nerve in polyneuropathy. *J Neurol Neurosurg Psychiatry*. 1974;37:647–652.
2. Cape CA. Sensory nerve action potentials of the peroneal, sural and tibial nerves. *Am J Phys Med*. 1971;50:220–229.
3. Keck C. The tarsal-tunnel syndrome. *J Bone Joint Surg* [*Am*]. 1962;44A: 180–182.
4. Lam SS. A tarsal-tunnel syndrome. *Lancet*. 1962;2:1354–1355.
5. Learmonth JR. The principle of decompression in the treatment on certain diseases of peripheral nerves. *Surg Clin North Am*. 1933;13:905–913.
6. Lee HJ, Bach JR, Delisa JA. Lateral dorsal cutaneous branch of the sural nerve: standardization in nerve conduction study. *Am J Phys Med Rehabil*. 1992;71:318–320.
7. Netter FH. *Atlas of Human Anatomy*. Summit, NJ: CIBA-GEIGY Corporation; 1989:508.
8. Pringle RM, Protheroe K, Mukherjee SK. Entrapment neuropathy of the sural nerve. *J Bone Joint Surg* [*Br*]. 1974;56B:465–468.
9. Roles NC, Maudsley RH. Radial tunnel syndrome. *J Bone Joint Surg* [*Br*]. 1972;54B:499–508.
10. Schuchmann JA. Isolated sural neuropathy: report of two cases. *Arch Phys Med Rehabil*. 1980;61:329–331.
11. Schuchmann JA. Sural nerve conduction: a standardized technique. *Arch Phys Med Rehabil*. 1977;58:166–168.
12. Seddon H. *Surgical Disorders of Peripheral Nerves*. Baltimore, MD: Williams & Wilkins; 1972:219.

Osteoid Osteoma of the Calcaneus: An Unusual Cause of Hindfoot Pain in an Adolescent Athlete

Thomas Rossi, MEd, ATC; Kenneth Levitsky, MD

ABSTRACT: Osteoid osteomas are distinctive, benign tumors of bone that cause localized pain. This problem, although rare in athletes, must be resolved before pain-free competition can resume. We present a case of a 14-year-old white, male football player who complained of heel pain. He was treated conservatively with ice, stretching, and a nonsteroidal anti-inflammatory drug (Advil). Postseason, his symptoms worsened and he was referred for orthopedic consultation. Radiography displayed a possible osteoid osteoma; a CT evaluation confirmed the diagnosis. The athlete was treated surgically for the condition, and following a 2-week immobilization and a 3-week rehabilitation program, the pain completely resolved.

The differential diagnoses of hindfoot pain include Achilles tendinitis, retrocalcaneal bursitis, Sever's disease, chronic ankle instability, and plantar fasciitis. The standard treatment of these conditions is primarily conservative and surgical intervention is rarely required. We present a report of an athlete with recalcitrant hindfoot pain. Diagnostic workup revealed an osteoid osteoma of the calcaneus which required surgical excision. The history, clinical presentation, diagnostic workup, and treatment is reviewed.

CASE REPORT

A 14-year-old white, male football player presented to the training room during the latter part of the football season complaining of heel pain. He complained of pain in the posterolateral aspect of the calcaneus. The pain had been intermittent during the past year but had recently become constant and more intense. The pain worsened with activity and had begun to adversely affect his performance. Physical evaluation revealed tenderness along the distal third of the Achilles tendon with tenderness and swelling in the retrocalcaneal area. Pain increased with active plantar flexion and dorsiflexion.

The athlete was removed from activity for 2 days; he was treated with ice and instructed to take a nonsteroidal anti-inflammatory drug (Advil). After 2 days, he had a significant reduction in symptoms and returned to limited activity with a heel lift to reduce stress on the Achilles tendon. He was able to finish the season with minimal soreness by icing after activity, doing heel cord stretching, and continuing to take Advil.

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Three weeks after the conclusion of the season, the athlete returned to the training room with similar symptoms; however, the pain had intensified, was constant throughout the day, and woke him at night. He also reported that he had been inactive during the past 3 weeks. At this point, the athlete was referred for orthopedic consultation.

The physical examination was remarkable for dramatic warmth, tenderness, and soft tissue swelling in the retrocalcaneal area. Plain radiography demonstrated a radiodense nidus with a radiolucent halo in the calcaneus on the superior aspect of the calcaneal tuberosity (Fig 1). The presumptive diagnosis was that of an osteoid osteoma of the calcaneus and the athlete was referred for computerized tomography (CT scan), which further defined the lesion and its location and was consistent with osteoid osteoma (Fig 2).

He was subsequently scheduled for surgical excision of the lesion from a lateral approach with CT-directed preoperative needle localization. At operation, the lesion was identified and removed in its entirety, and the surrounding sclerotic bone was removed with a curette (Fig 3). The pathologic evaluation confirmed the diagnosis of osteoid osteoma of the calcaneus. Postoperatively, the athlete was placed in a cast for 2 weeks to allow the soft tissues to heal. He performed 3 weeks of rehabilitation, consisting of active range of motion, heel cord stretching, progressive resistance exercise, and proprioception. Presently, his pain has completely abated and he has returned to full activities without restriction.

DISCUSSION

Jaffe[7] described osteoid osteoma as a distinctive, benign osteoblastic tumor composed of osteoid and atypical bone, generally occurring in younger adults, with males affected twice as often as females. Osteoid osteomas account for 10% of all benign bone tumors, occurring most commonly in the proximal femur and diaphysis of the tibia.[2,5] Up to 10% of osteoid osteomas occur in the bones of the foot, with 2% to 3% of them occurring in the calcaneus.[6] Ninety percent of patients are under 25 years of age, and the condition is rare before 2 years or past 50 years of age.[4]

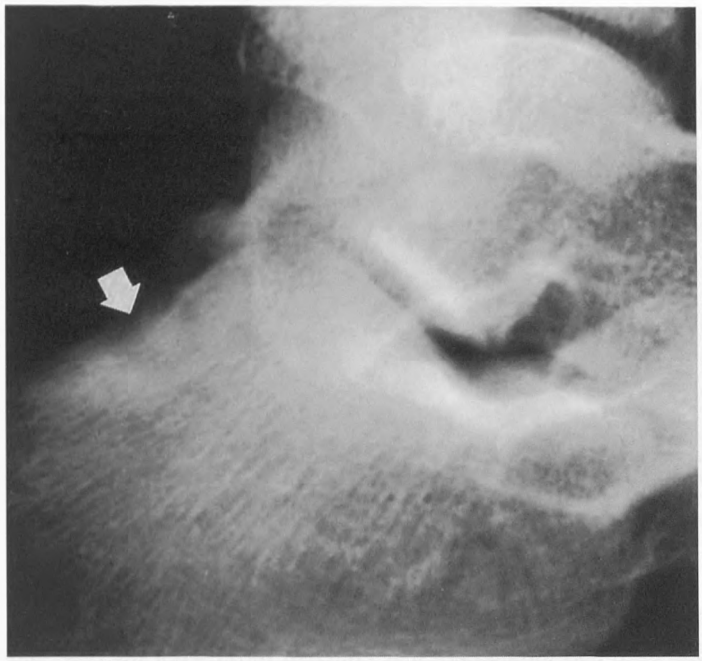

Fig 1. Plain radiograph of the lesion in the calcaneus. There is a radiopaque nidus (arrow) with a radiolucent halo surrounded by a sclerotic rim of reactive bone in the superior-posterior calcaneus. Radiopaque areas appear light or white on the exposed film; radiolucent areas appear dark on the exposed film. (Note: Nidus is the point of origin or focus of a morbid process; halo is a luminous or colored circle; and a sclerotic rim is hard or hardening bone).

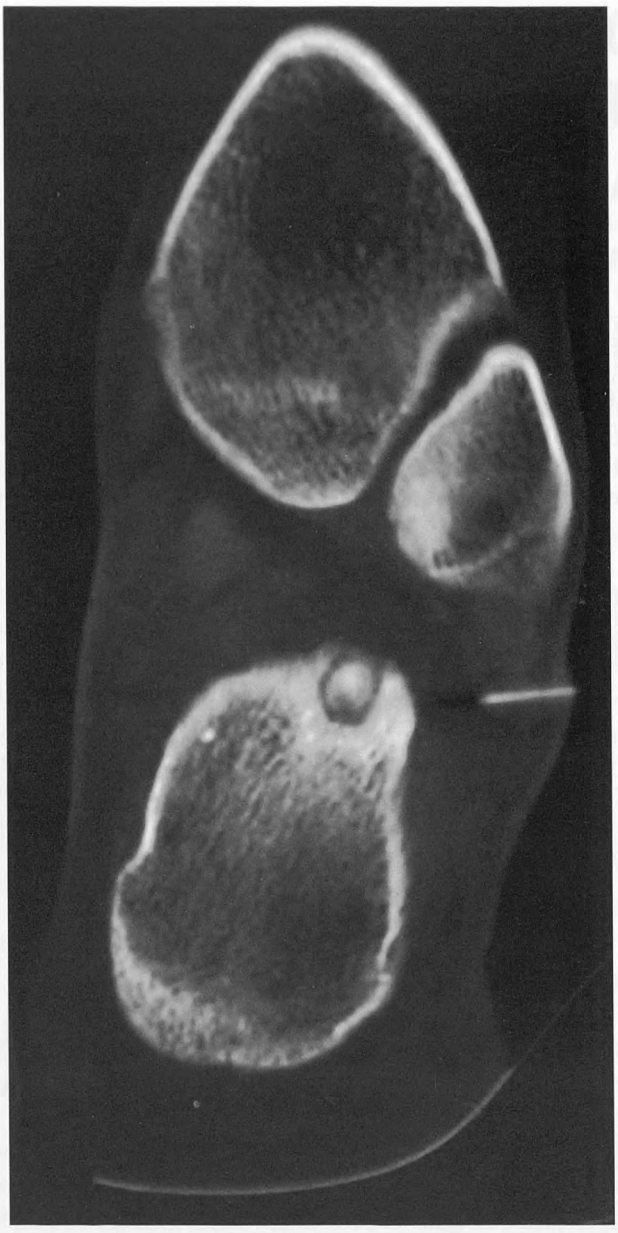

Fig 2. Computerized tomography (CT scan) of the lesion with fine needle localization.

The tumor is characterized by a central nidus that usually measures 1 cm in diameter. The nidus consists of osteoid and osseous tissue within a highly vascularized connective tissue matrix. Over a period of months or years, the nidus stimulates the production of dense bone which surrounds the lesion and may extend out from it.[9] The exact etiology remains controversial with most authors favoring neoplasia[7,10,11] over an inflammatory cause.[12]

The tumor typically causes localized pain that is often dramatically relieved by ingestion of aspirin.[5] The relief is generated from the inhibition of prostaglandins and mediators that are the product of bone formation. Therefore, the new bone formation precedes any inflammation. Initially, the pain is vague and intermittent, but, as the tumor progresses, the pain becomes more severe and constant, especially at night. At this point, the patient is compelled to seek medical attention.

Clinical symptoms include exquisite local tenderness, local soft tissue swelling, increased overlying skin temperature, and, depending on the location of the lesion, muscle weakness and atrophy.[3] The disparity between the intense pain and the small physical size of the tumor may be explained by the presence of nerve fibers in the nidal and perinidal tissues.[13] Duration of symptoms usually ranges from 6 months to 2 years before the patient seeks medical attention.

Radiographically, the lesion may appear as sclerotic thickening of the bone with a radiolucent nidus. However, the nidus may not appear on initial x-ray. A bone scan can be performed to verify the diagnosis in those patients with a high index of suspicion. Following a positive bone scan, computerized tomography is done to confirm the location of the lesion and aid the surgical approach.[8]

In most cases, treatment consists of surgical excision of the nidus and the surrounding sclerotic bone. Failure to excise the entire lesion may result in recurrence. The patient usually has immediate relief of pain following excision and remains asymptomatic thereafter.

Some lesions may regress spontaneously over time[1]; however, the pain often dictates immediate removal to relieve the symptoms.

Although this condition is uncommon, the athletic trainer should become suspicious of all conditions which do not respond to treatment or those which present unusual signs and symptoms. Athletes should be re-evaluated or referred if they experience an increase of signs and symptoms in the absence of

Fig 3. Gross appearance of the osteoid osteoma and surrounding sclerotic bone after excision.

activity or additional trauma. Injuries such as strains, sprains, tendinitis, or bursitis typically respond to rest, ice, and anti-inflammatory medication. Tumors are rare in the athletic setting; however, young athletes who present with constant intense pain that awakens them at night should be referred for physician consultation.

REFERENCES

1. Crenshaw AH, ed. *Campbell's Operative Orthopedics*. St Louis, MO: CV Mosby Co; 1971:1350–1351.
2. Dahlin DC. *Bone Tumors: General Aspects and an Analysis of 2,276 Cases*. Springfield, IL: Thomas; 1957:62–69.
3. Gambling FO, Yale I. *Clinical Foot Roentgenology*. 2nd ed. New York, NY: Robert E Krieger Publishing Co; 1975:108.
4. Greenfield GB. *Radiology of Bone Disease*. 2nd ed. Philadelphia, PA: JB Lippincott Co; 1975:447–449.
5. Healey JH, Ghelman B. Osteoid osteoma and osteoblastoma: current concepts and recent advances. *Clin Orthop.* 1986;204:76–85.
6. Jackson RP, Reckling FW, Mantz FA. Osteoid osteoma and osteoblastoma—similar histologic lesions with different natural histories. *Clin Orthop.* 1977;128:303–313.
7. Jaffe HL. Osteoid Osteoma. A benign osteoblastic tumor composed of osteoid and atypical bone. *Arch Surg.* 1935;31:709–728.
8. Jahss MH. *Disorders of the Foot and Ankle. Medical and Surgical Management*. Philadelphia, PA: WB Saunders Co; 1991:1657–1658.
9. Meissner PJ, Mauro G. Osteoid osteoma: a literature review and case report. *J Foot Surg.* 1981;20:25–27.
10. Robbins SL. *Pathologic Basis of Disease*. Philadelphia, PA: WB Saunders Co; 1974:1450.
11. Scajowicz F, Lemos C. Osteoid Osteoma and osteoblastoma. Closely related entities of osteoblastic derivation. *Acta Orthop Scand.* 1970;41:272.
12. Vickers C, Pugh P, Irvins J. Osteoid osteoma: a 15 year follow-up of an untreated patient. *J Bone Joint Surg [Am].* 1959;41A:357.
13. Wu K. Osteoid osteoma of the foot. *J Foot Surg.* 1991;30:190–194.

Abstracts

Clint Thompson, MS, ATC

Andersen SB, Terwilliger DM, Denegar CR. Comparison of open versus closed kinetic chain test positions for measuring joint position sense. *J Sport Rehabil.* 1995;4:165–171.

The purpose of the study was to determine if a difference exists in the reproducibility of knee joint flexion angles in an open versus a closed kinetic chain. Thirty generally healthy subjects (12 males, 18 females; mean age 28.8 years) participated. Subjects actively reproduced small, medium, and large knee flexion angles (with target angles of 15°, 45°, and 75°, respectively) in an open and closed kinetic chain while being videotaped. Goniometric measurements were taken from the videotape of initial and reproduced joint angles. Data were analyzed using ANOVA with repeated measures on kinetic chain test position and joint angle. Subjects more accurately reproduced knee flexion angles in a closed kinetic chain position. The main effect for angle and the interaction of angle and test position were nonsignificant. The results indicate that knee joint position is more accurately reproduced in closed kinetic chain. Closed kinetic chain testing is also a more functional assessment of joint position sense, and thus closed kinetic chain assessment of lower extremity joint position sense is recommended.

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Schaub PA, Worrell TW. EMG activity of six muscles and VMO:VL ratio determination during a maximal squat exercise. *J Sport Rehabil.* 1995;4:195–202.

During knee rehabilitation, squats are a commonly used closed kinetic chain exercise. We have been unable to locate data reporting EMG activity of lower extremity musculature during maximal effort squats and the contribution of gastrocnemius and gluteus maximum muscles. Therefore, the purposes of this study were: a) to quantify EMG activity of selected lower extremity muscles during a maximal isometric squat and during a maximal voluntary isometric contraction (MVIC), and b) to determine ratios between the vastus medialis oblique (VMO) and vastus lateralis (VL) during maximal isometric squat and MVIC testing. Twenty-three subjects participated in a single testing session. Results are as follows: intraclass correlations for MVIC testing and squat testing ranged from .60 to .80 and .70 to .90, respectively. Percentage MVIC during the squat was as follows: rectus femoris 40 ± 30%, VMO 90 ± 70%, VL 70 ± 40%, hamstrings 10 ± 10%, gluteus maximus 20 ± 10%, and gastrocnemius 30 ± 20%. No statistical difference existed in VMO:VL ratios during MVIC or squat testing. We conclude that large variations in muscle recruitment patterns occur between individuals during isometric squats.

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Keskula DR, Duncan JB, Davis VL. Rehabilitation following medical meniscal transplant: a case study. *J Sport Rehabil.* 1995;4:203–209.

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

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Kaminski TW, Perrin DH, Mattacola CG, Szczerba JE, Bernier JN. The reliability and validity of ankle inversion and eversion torque measurements from the Kin Com II isokinetic dynamometer. *J Sport Rehabil.* 1995; 4:210–218.

This study examined the test-retest reliability of a prototype device used to measure ankle inversion and eversion isokinetic average torque values. The purpose of this paper was to illustrate a situation where common isokinetic measures were reliable but not valid. Concentric and eccentric average torque was assessed at 90°/s on the Kin Com II dynamometer using 14 healthy subjects in two sessions; a manufactured prototype ankle inversion/eversion attachment device was used. Reliability was assessed by performing separate intraclass correlations (ICC 2,1) on the results. The data indicated that the average torque calculated from the clockwise direction was consistently higher than those values from the counterclockwise direction, regardless of ankle movement or side measured. The validity of this prototype device to accurately measure average torque for those two ankle motions is questionable. This finding demonstrates a situation where the measures appear to be reliable while the validity of the device used to obtain the measures is suspect.

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Tewes DP, Fischer DA, Quick DC, Zamberletti F, Powell J. Lumbar transverse process fractures in professional football players. *Am J Sports Med.* Jul-Aug 1995;23:507–509.

In the general population, fractures of the transverse processes of lumbar vertebrae occur in cases of high-energy blunt trauma, often in motor vehicle accidents. Football players may incur the same fractures, but the circumstances and outcomes are different in this specific subgroup. A review of 29

cases among National Football League players reveals that associated visceral injuries are rare, and the time lost from sports is only an average of 3.5 weeks.

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Hughes C 4th, Hasselman CT, Best TM, Martinez S, Garrett WE Jr. Incomplete, intrasubstance strain injuries of the rectus femoris muscle. *Am J Sports Med.* Jul-Aug 1995;23: 500–506.

Rectus femoris muscle strain injuries commonly occur at the distal muscle-tendon junction of the quadriceps tendon. However, we have recently recognized a pattern of strain injury that consists of an incomplete intrasubstance tear at the muscle-tendon junction formed by the deep tendon of the muscle's indirect head and those muscle fibers originating from this tendon. These injuries are found more proximally within the thigh than the classic distal rectus femoris muscle strain. We reviewed 10 athletes with these intrasubstance tears, all of whom had diagnostic imaging performed using computed tomography or magnetic resonance imaging or both. Two of these patients required surgical intervention. The mechanism of injury usually involved kicking or sprinting. All patients had chronic thigh pain or an anterior thigh mass or both. Physical examination revealed thigh asymmetry and a nontender to mildly tender intrasubstance muscle mass. Magnetic resonance imaging demonstrated abnormal signal intensity centered about the intramuscular tendon of the indirect head of the muscle. Surgical findings included a mass of fibrous scar and fatty tissue encasing the deep tendon. Surgical removal of this fibrous mass appears curative. We contrast this injury from distal strains of the rectus femoris muscle, as well as from soft tissue neoplasms.

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Hasselman CT, Best TM, Hughes C 4th, Martinez S, Garrett WE Jr. An explanation for various rectus femoris strain injuries using previously undescribed muscle architecture. *Am J Sports Med.* Jul-Aug 1995;23:493–499.

We performed cadaveric dissection of the rectus femoris muscle to correlate the various lesions of strain injury seen with imaging studies to the muscular anatomy. The proximal tendon is composed of a superficial, anterior portion from the direct head, and a deep intramuscular portion from the indirect head. The muscle fibers arising from the anterior superficial tendon of the direct head travel in a posterior and distal direction to insert on the posterior tendon of insertion, giving the proximal muscle a unipennate architecture. Muscle fibers from the intramuscular tendon of the indirect head originate on both the medial and lateral sides of the tendon and insert on the distal posterior tendon to create its bipennate structure. Three chronic strain injuries involving the midmuscle belly substance were explored grossly and microscopically. It appears that one type of acute strain injury occurs in the midmuscle belly with disruption of the muscle-tendon junction of the intramuscular tendon resulting in local hemorrhage and edema. More chronically, this hematoma organizes into a fatty, loose connective tissue encasement of the deep intramuscular proximal tendon. Serous fluid from the hematoma may remain within the connective tissue sheath, creating a pseudocyst with the deep intramuscular tendon of the indirect head at its center. The muscle's anatomy helps to explain a different rectus femoris strain injury.

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Fredericson M, Bergman AG, Hoffman KL, Dillingham MS. Tibial stress reaction in runners. Correlation of clinical symptoms and scintigraphy with a new magnetic resonance imaging grading system. *Am J Sports Med.* Jul-Aug 1995;23:472–481.

Medial tibial pain in runners has traditionally been diagnosed as either a shin splint syndrome or as a stress fracture. Our work using magnetic resonance imaging suggests that a progression of injury can be identified, starting with periosteal edema, then progressive marrow involvement, and ultimately frank cortical stress fracture. Fourteen runners, with a total of 18 symptomatic legs, were evaluated and, within 10 days, referred for radiographs, a technetium bone scan, and a magnetic resonance imaging scan. In 14 of the 18 symptomatic legs, magnetic resonance imaging findings correlated with an established technetium bone scan grading system and more precisely defined the anatomic location and extent of injury. We identified clinical symptoms, such as pain with daily ambulation and physical examination findings, including localized tibial tenderness and pain with direct or indirect percussion, that correlated with more severe tibial stress injuries. When clinically warranted, we recommend magnetic resonance imaging over bone scan for grading of tibial stress lesions in runners. Magnetic resonance imaging is more accurate in correlating the degree of bone involvement with clinical symptoms, allowing for more accurate recommendations for rehabilitation and return to impact activity. Additional advantages of magnetic resonance imaging include lack of exposure to ionizing radiation and significantly less imaging time than three-phase bone scintigraphy.

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Larsen B, Andreasen E, Urfer A, Mickelson MR, Newhouse KE. Patellar taping: a radiographic examination of the medial glide technique. *Am J Sports Med.* Jul-Aug 1995;23:465–471.

The purpose of this study was to radiographically determine the effectiveness of the McConnell medial glide patellar taping technique. Twenty apparently healthy men, between ages 18 and 35, participated in this study. Subjects underwent a series of three radiographs in a modified Merchant view. First, a bilateral tangential view of the patellofemoral joints was taken to establish a baseline. Next, the same view was obtained with the experimental knees taped using the McConnell medial glide

technique. Subjects then underwent a standardized exercise protocol to stress the tape and the accompanying knee structures. This was followed by a third view of the patellofemoral joints. Radiographs were measured using the Merchant congruence angle and analyzed statistically with dependent, mean difference tests. Results from this study indicate that the McConnell medial glide technique was effective in significantly moving the patella medially ($p = .003$), but that the tape was ineffective in maintaining this significance after exercise ($p < .001$). In 3 subjects (15%) of this sample, the tape was ineffective in moving the patella medially in any degree. One interesting finding was that exercise caused a statistically significant ($p = .016$) lateral shift from baseline in the control knees. This may suggest some clinical significance for patellar taping in preventing excessive lateral shift.

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Martin DR, Garth WP Jr. Results of arthroscopic debridement of glenoid labral tears. *Am J Sports Med.* Jul-Aug 1995;23:447–451.

We studied the long-term results of a prospectively selected group of 24 patients with 12 anteroinferior and 12 posterior glenoid labral lesions; all patients had functional instability but none had ligamentous detachment. After arthroscopic debridement, patients involved in throwing sports were not allowed to return to full athletic activity until full strength of the external rotators was achieved and documented on isokinetic evaluation. Follow up was 36 to 72 months with an average of 48 months. Follow-up isokinetic evaluation revealed an average + 4.4% and + 8.6% concentric strength and −4.3% and −0.4% eccentric strength of the operated shoulder compared with the uninvolved shoulder at 90° and 180°/sec, respectively. Long-term good or excellent results were achieved in 21 patients, and 16 were functioning at their preinjury level of sports activities. Sixty-two percent of baseball pitchers were unimpaired in pitching. The average University of California Los Angeles shoulder rating score was 31 of 35 (11 excellent, 10 good, and 3 poor) and the average Rowe-Zarins ratings scale was 85 of 100 (8 excellent, 13 good, and 3 poor). These results justify an initial arthroscopic debridement of anteroinferior or posterior labral flap tears rather than capsulorrhaphy when there is no gross instability or Bankart lesion.

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Veltri DM, Deng XH, Torzilli PA, Warren RF, Maynard MJ. The role of the cruciate and posterolateral ligaments in stability of the knee. A biomechanical study. *Am J Sports Med.* Jul-Aug 1995;23:436–443.

The role of the posterolateral and cruciate ligaments in restraining knee motion was studied in 11 human cadaveric knees. The posterolateral ligaments sectioned included the lateral collateral and arcuate ligaments, the popliteofibular ligament, and the popliteal tendon attachment to the tibia. Combined sectioning of the anterior cruciate and posterolateral ligaments resulted in maximal increases in primary anterior and posterior translations at 30° of knee flexion. Primary varus, primary internal, and coupled external rotation also increased and were maximal at 30° of knee flexion. Combined sectioning of the posterior cruciate and posterolateral ligaments resulted in increased primary posterior translation, primary varus and external rotation, and coupled external rotation at all angles of knee flexion. Examination of the knee at 30° and 90° of knee flexion can discriminate between combined posterior cruciate ligament and posterolateral injury and isolated posterolateral injury. The standard external rotation test performed at 30° of knee flexion may not be routinely reliable for detecting combined anterior cruciate and posterolateral ligament injury. However, measurements of primary anterior-posterior translation, primary varus rotation, and coupled external rotation may be used to detect combined anterior cruciate and posterolateral ligament injury.

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Ottaviani RA, Ashton-Miller JA, Kothari SU, Wojtys EM. Basketball shoe height and the maximal muscular resistance to applied ankle inversion and eversion moments. *Am J Sports Med.* Jul-Aug 1995;23:418–423.

To determine if the height of a basketball shoe alters the maximal inversion and eversion moment that can be actively resisted by the ankle in the frontal plane, we tested 20 healthy, young adult men with no recent ankle injuries. Subjects underwent unipedal functional ankle strength testing under weightbearing conditions at 0°, 16°, and 32° of ankle plantar flexion using a specially designed testing apparatus. Testing was performed with the subject wearing either a low- or a three-quarter-top basketball shoe. Shoe height did not significantly affect an individual's ability to actively resist an eversion moment at any angle of ankle plantar flexion. However, tests at 0° of ankle plantar flexion demonstrated that the three-quarter-top basketball shoe we tested significantly increased the maximal resistance to an inversion moment by 29.4%. At 16° of ankle plantar flexion, inversion resistance was also significantly improved by 20.4%. These results show that athletic shoe height can significantly increase the active resistance to an inversion moment in moderate ankle plantar flexion. The findings apply to a neutral foot position in the frontal plane, an orientation equivalent to the early phase of a potential ankle sprain.

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Lofvenberg R, Karrholm J, Sundelin G, Ahlgren O. Prolonged reaction time in patients with chronic lateral instability of the ankle. *Am J Sports Med.* Jul-Aug 1995;23:414–417.

Impaired proprioception has been suggested as one cause of chronic lateral instability of the ankle. We subjected 15 ankles in 13 patients with symptoms of chronic lateral instability to sudden angular displacement. The reaction times in the peroneus longus

and the tibialis anterior muscles were recorded and compared with those from 15 control ankles. Significantly longer ipsilateral reaction time was recorded in the patients (65 ms) compared with the controls (49 ms). We concluded that delayed proprioceptive response to sudden angular displacement of the ankle may predispose an individual to or be a cause of chronic lateral instability of the ankle.

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Andrews JR, Timmerman LA. Outcome of elbow surgery in professional baseball players. *Am J Sports Med.* Jul-Aug 1995;23:407–413.

We reviewed the records of 72 professional baseball players who underwent arthroscopic or open elbow surgery. The most common diagnoses were posteromedial olecranon osteophyte (65%), ulnar collateral ligament injury (25%), and ulnar neuritis (15%). Intraarticular loose bodies were found in 39% of the patients. Fifty-nine patients (82%) were observed for a minimum of 24 months, with an average of 42 months' follow up. Forty-seven players (80%) returned to play for a minimum of one season (73% at the same or higher level of play), and 17% of the players retired initially because of their elbow injury. One third of the players required two or more surgical procedures, with 25% of these patients requiring an ulnar collateral ligament reconstruction after removal of a posteromedial olecranon osteophyte. The patients with posteromedial olecranon osteophytes had the highest rate of reoperation, and patients who underwent ulnar collateral ligament reconstruction had a higher rate of return to play. The incidence of ulnar collateral ligament injuries was most likely underestimated in this group of athletes, with initial treatment directed at the secondary injuries instead of the primary ulnar collateral ligament injury.

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Bynum EB, Barrack RL, Alexander AH. Open versus closed chain kinetic exercises after anterior cruciate ligament reconstruction. A prospective randomized study. *Am J Sports Med.* Jul-Aug 1995;23:401–406.

We conducted a prospective, randomized study of open and closed kinetic chain exercises during accelerated rehabilitation after anterior cruciate ligament reconstruction to determine if closed kinetic chain exercises are safe and if they offer any advantages over conventional rehabilitation. The closed kinetic chain group used a length of elastic tubing, the Sport Cord, to perform weightbearing exercises and the open kinetic chain group used conventional physical therapy equipment. Results are reported with a minimum 1-year follow up (mean, 19 months). Pre- and postoperative evaluation included the Lysholm knee function scoring scale, Tegner activity rating scale, and KT-1000 arthrometer measurements. Overall, stability was restored in over 90% of the knees. Preoperative patellofemoral pain was reduced significantly; 95% of the patients had a full range of motion. The closed kinetic chain group had lower mean KT-1000 arthrometer side-to-side differences, less patellofemoral pain, was generally more satisfied with the end result, and more often thought they returned to normal daily activities and sports sooner than expected. We concluded that closed kinetic chain exercises are safe and effective and offer some important advantages over open kinetic chain exercises. As a result of this study, we now use the closed kinetic chain protocol exclusively after anterior cruciate ligament reconstruction.

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Field LD, Callaway GH, O'Brien SJ, Altchek DW. Arthroscopic assessment of the medial collateral ligament complex of the elbow. *Am J Sports Med.* Jul-Aug 1995;23:396–400.

The extent that the medial collateral ligament complex could be visualized by arthroscopy was determined in 10 fresh cadaveric elbows from 10 individuals. We carefully exposed the medial collateral ligament complex through a muscle-splitting incision before performing arthroscopy. The anterior and posterior bundles were identified and marked by placing 4.0 nylon sutures deep to the bundles to aid in arthroscopic visualization. A portion of the anterior bundle was visible in only one elbow and in that elbow only the most anterior 25% of the anterior bundle was seen. Attempts to visualize the anterior bundle through additional portals were unsuccessful. Varying the flexion angle of the cadaveric elbow from 0° to 130° also failed to improve visualization. Conversely, the entire posterior bundle, including humeral and ulnar insertion sites, could be seen in all 10 specimens using the posterior portals. We also noted that direct pressure was placed on the ulnar nerve in all specimens when the arthroscope or any arthroscopic instrument was advanced into the posteromedial gutter in contact with the posterior bundle because of its proximity immediately adjacent to the ulnar nerve. The inability to reliably see the anterior bundle and the humeral or ulnar insertion sites of this ligament may limit the value of the arthroscope when assessing medial collateral ligament injuries. Additionally, great care should be taken when using the arthroscope or other instruments in the posteromedial gutter because the ulnar nerve lies immediately adjacent to the thin posterior bundle and capsule.

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Mandelbaum BR, Myerson MS, Forster R. Achilles tendon ruptures. A new method of repair, early range of motion, and functional rehabilitation. *Am J Sports Med.* Jul-Aug 1995;23:392–395.

We prospectively treated 29 athletes who had Achilles tendon ruptures according to a functional rehabilitation protocol. The 25 male and 4 female patients had a mean age of 35 years (range, 19 to 56). The repair was performed with a Krackow suture of No. 2 nonabsorbable polyfilament. Patients began range-of-motion exercises 72 hours after surgery, used a posterior splint for 2

weeks, and then began ambulation in a hinged orthosis. Six weeks after surgery, use of the orthosis was discontinued, full weightbearing was allowed, and progressive resistance exercises were initiated. Isokinetic strength and endurance testing were performed at 3, 6, and 12 months after surgery. There were no reruptures. Two patients developed superficial wound infections that responded to debridement or local wound care. One patient suffered a pulmonary embolism. At 3 months' follow-up, isokinetic testing showed the mean functional deficits were 36% and 35% of the opposite leg at 60° and 120°/sec, respectively. By 6 months, the mean deficits were 2.9% and 2.3% at 60° and 120°/sec, respectively. All patients returned to preinjury activity levels at a mean of 4 months (range, 3 to 7) after repair. By 12 months, there were no significant differences in ankle motion, isokinetic strength, or endurance as compared with the uninvolved side.

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Noyes FR, Barber-Westin SD. The treatment of acute combined ruptures of the anterior cruciate and medial ligaments of the knee. *Am J Sports Med.* Jul-Aug 1995;23:380–389.

We performed a prospective study of 46 patients with ruptures of the anterior cruciate ligament and medial ligamentous structures. All patients had anterior cruciate ligament allograft reconstructions. Group I comprised 34 patients in whom all of the medial structures were ruptured (parallel and oblique fibers of the superficial medial collateral ligament and the posteromedial capsule) and were treated operatively. In Group II (12 patients), the superficial medial ligament fibers only were ruptured and these were treated nonoperatively. All patients started an immediate motion and rehabilitation program. Forty-four patients returned for follow up at a mean of 5.3 years (range, 2 to 8.9) postoperatively. The results were assessed using the Cincinnati Knee Rating System. At follow-up, 20 knees (59%) in Group I and 9 knees (73%) in Group II had less than 3 mm of increased displacement on KT-1000 arthrometer testing (134 N). The overall rate of anterior cruciate ligament graft failure was 15%: six (18%) in Group I and one (8%) in Group II. No patient had more than 2 mm of increase on valgus stress testing at 5° or 25° of knee flexion. The overall ratings were as follows: Group I, 20 knees (58%) excellent or good and 14 knees (42%) fair or poor; and Group II, 11 knees (91%) excellent or good and one knee (9%) fair. Knee motion complications and patellofemoral symptoms were common in the patients rated fair or poor in Group I.

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King LA, VanSant AF. The effect of solid ankle-foot orthoses on movement patterns used in a supine-to-stand rising task. *Phys Ther.* Nov 1995;75:952–964

BACKGROUND AND PURPOSE—Within dynamical pattern theory, ankle motion can be proposed to be a control variable, and solid ankle-foot orthoses (SAFOs) can be considered a constraint to ankle movement. The purpose of this study was to examine the effect of SAFOs on movement patterns used to rise from the supine position to erect stance. *SUBJECTS*—Thirty-nine nondisabled young adults, ranging in age from 20 to 28 years ($\overline{X}$ = 22.7, SD = 1.87), participated. *METHODS*—Subjects were videotaped while rising from a supine position on a floor mat. Each subject performed 10 trials under each of four conditions: without SAFOs, right SAFO, left SAFO, and bilateral SAFOs. Movement patterns were described within three body components (ie. upper extremities, axial region, and lower extremities) by determining the mode and the incidence of each movement pattern under each condition. The subjects' mode movement patterns in the no SAFO condition were compared with mode movement patterns in the SAFO conditions using McNemar tests. *RESULTS*—Without SAFOs, subjects rose most commonly using a push and reach pattern of the upper extremities, a forward with rotation pattern in the trunk, and an asymmetrical squat in the lower extremities. Changes in the incidence of movement patterns occurred in all of the SAFO conditions when compared with the no SAFO condition. These changes resulted in more asymmetry when SAFOs were worn, and asymmetry was most notable in the axial region. *CONCLUSIONS AND DISCUSSION*—From a dynamic pattern theory perspective, ankle motion is a control variable for the supine-to-stand rising task.

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Ballantyne BT, French AK, Heimsoth SL, Kachingwe AF, Lee JB, Soderberg GL. Influence of examiner experience and gender on interrater reliability of KT-1000 arthrometer measurements. *Phys Ther.* Oct 1995;75:898–906.

BACKGROUND AND PURPOSE—Measurements of the integrity of knee ligaments are used to diagnose injuries as well as to document the state of recovery. Many factors, such as gender and experience of the examiner, are capable of influencing the reliability of such measurements. The purpose of this study was to determine the effects on interrater reliability of measurements obtained using the KT-1000 arthrometer of experience, gender, and leg tested. *SUBJECTS*—Two experienced examiners (1 male, 1 female) and two inexperienced examiners (1 male, 1 female) tested 22 subjects with unilateral anterior cruciate ligament (ACL) pathology. *METHODS*—The leg with an ACL injury and the uninjured leg of each subject were evaluated by all four examiners within one test session using 67N, 89N, maximum manual, and active anterior drawer tests. *RESULTS*—Greater anterior displacement values were found in the legs with ACL injury than in the uninjured legs. Reliability estimates, as assessed by intraclass correlation coefficients (2,k) and measurement error (SEM), suggest that therapist experience may be a more important factor influencing reliability than gender. *CONCLUSIONS AND DISCUSSION*—Given the magnitude of the errors obtained for tests routinely conducted in the clinic using the KT-1000

arthrometer, we recommend that repeated measurements should be taken by the same examiners whenever possible.

Karst GM, Willett GM. Onset timing of electromyographic activity in the vastus medialis oblique and vastus lateralis muscles in subjects with and without patellofemoral pain syndrome. *Phys Ther*. Sep 1995;75:813–823.

BACKGROUND AND PURPOSE—Inappropriate neural control of the quadriceps femoris muscle group has been implicated in patellofemoral pain syndrome (PFPS). This study investigated the timing of initial electromyographic (EMG) activity of the vastus medialis oblique muscle (VMO) and the vastus lateralis muscle (VL) in asymptomatic subjects and subjects with PFPS during reflex and voluntary muscle activity. *SUBJECTS*—Fifteen symptomatic subjects (SYMP group) (9 with bilateral symptoms) and 12 asymptomatic subjects (ASYMP group) participated. Both knees were tested in the ASYMP group and only the symptomatic knees were tested in the SYMP group, resulting in a total of 24 data sets from each group. *METHODS*—Electromyographic data were recorded from the VMO and VL under three conditions: reflex knee extension (RFLX) elicited by a patellar tendon tap, and active knee extension in non-weight-bearing (NWB) and weight-bearing (WB) situations. For each condition, EMG activity onset times for the VMO and VL were determined from ensemble averages of four trials. *RESULTS*—There were no differences between the SYMP and ASYMP groups with respect to the relative timing of initial VMO and VL activity under any of the three conditions tested. Mean timing differences for both groups were less than .25 msec under reflex conditions and less than 4 msec for active knee extension under both WB and NWB conditions. *CONCLUSIONS AND DISCUSSION*—These findings contradict a previous report of differences in reflex timing related to PFPS. Differences in the relative timing of onset of EMG activity of the VMO and VL during voluntary knee extension were not significant between SYMP and ASYMP groups, and were not related to the relative timing differences observed during reflex testing.

Host HH. Scapular taping in the treatment of anterior shoulder impingement. *Phys Ther*. Sep 1995;75:803–812.

The purpose of this case report is to describe how taping designed to promote proximal scapular stability was used in conjunction with other physical therapy interventions to manage a patient with anterior shoulder impingement. The taping technique is described in detail. The evaluation and treatment of a patient with an 8-month history of shoulder pain are described as an example of when this type of taping procedure may be indicated. This case report demonstrates that a patient was able to return to all of his regular overhead sports activities without pain following scapular taping used in combination with a home exercise program. Presumably, the improved resting position of the scapula corrected faulty scapulothoracic joint movements.

Binkley J, Stratford PW, Gill C. Interrater reliability of lumbar accessory motion mobility testing. *Phys Ther*. Sep 1995;75:786–92; discussion 793–795.

BACKGROUND AND PURPOSE—This study examined the interrater agreement, or reliability, of accessory motion mobility testing of the lumbar spine in patients with low back pain. *SUBJECTS*—Subjects were 18 patients with low back pain referred to the physical therapy outpatient department of a university teaching hospital. *METHODS*—Six orthopedic physical therapists evaluated the posterior-anterior (P-A) accessory motion mobility at each of six levels, L-1 to the sacral base, on each subject. The mobility was recorded on a nine-point scale, and reproduction of pain was noted. The physical therapists noted any level at which mobility or pain findings were of significance to treat. To evaluate agreement on the identification of spinal levels, therapists were asked to identify one spinous process, which was arbitrarily marked on each subject. Kappa analyses and intraclass correlation coefficients (ICCs) were calculated to evaluate agreement on the level of the marked segment and the mobility at that level, respectively. *RESULTS*—The ICC for determination of the marked level was R(2,1) = .69 (95% confidence interval = .53–.82). The ICC for mobility findings at the marked level was R(2,1) = .25 (95% confidence interval = 0–.44). A secondary Kappa analysis to determine agreement on treatment decision making demonstrated similarly low levels of agreement. *CONCLUSIONS AND DISCUSSION*—There is poor interrater agreement on determination of the segmental level of a marked spinous process. There is poor interrater reliability of P-A accessory mobility testing in the absence of corroborating clinical data. Caution should be exercised when physical therapists make clinical decisions related to the evaluation of motion at a specific spinal level using P-A accessory motion testing.

Lunsford BR, Perry J. The standing heel-rise test for ankle plantar flexion: criterion for normal. *Phys Ther*. Aug 1995;75:694–698.

Providing the resistance has long been a standard test of muscle strength. Through the use of extremities acting as levers, clinicians have been able to effectively apply resistance to all muscle groups except the ankle plantar flexors. As a result, a standing heel-rise test that uses body weight as the resistance has been substituted. The number of heel-rises that represent normal plantar-flexor strength and the ability of subjects to repeatedly use that strength remain unresolved. Because

walking is an endurance task, the hypothesis tested by this study was that individuals without known weakness would be able to perform more than the standard recommended one to five standing heel-rises. The purpose of this study was to measure the number of standing heel-rises that individuals without known weakness could accomplish. *SUBJECTS*—Two hundred three subjects were studied for their ability to do standing heel-rises, as is done when testing plantar-flexion strength using the upright test. There were 122 male subjects and 81 female subjects, ranging in age from 20 to 59 years. *METHODS*—Each subject was asked to do as many standing heel-rises as he or she could, with careful monitoring of body and limb alignment and of ankle motion, with specific criteria for stopping. *RESULTS*—The average number of heel-rises was 27.9 (SD = 11.1, minimum = 6, maximum = 70) for all groups and both genders, with no differences between male and female subjects. The lower 99% confidence interval was 25. *CONCLUSIONS AND DISCUSSION*—A recommendation is made to change the standard of testing plantar-flexion function, when using the standing heel-rise test, to require 25 repetitions for a grade of Normal.

Mueller MJ, Minor SD, Schaaf JA, Strube MJ, Sahrmann SA. Relationship of plantar-flexor peak torque and dorsiflexion range of motion to kinetic variables during walking. *Phys Ther*. Aug 1995;75:684–693.

BACKGROUND AND PURPOSE—Limited ankle plantar-flexor moments and power during walking have been documented in several patient populations and are believed to contribute to gait deviations. The primary purpose of this study was to determine the relationship of plantar-flexor peak torque (PFPT) and dorsiflexion range of motion (ROM) to peak ankle moments and power during walking in a group of subjects without diabetes mellitus (DM) and in a group of subjects with DM and associated peripheral neuropathies. *SUBJECTS*—Nineteen subjects, 9 with DM and associated peripheral neuropathies (mean age = 58 years, SD = 14, range = 35–75 years) and 10 without DM (mean age = 57 years, SD = 11, range = 37–68 years), were evaluated. *METHODS*—The following data were collected on all subjects: PFPT, dorsiflexion ROM, and ankle moments and power during walking (using a two-dimensional link-segment model). Hierarchical multiple regression was used for data analysis. *RESULTS*—Plantar-flexor peak torque made substantial contributions to the ankle moment (40%) and ankle plantar-flexor power (53%) during walking. There also was a high correlation between PFPT and dorsiflexion ROM ($r = .78$) and between dorsiflexion ROM and ankle power ($r = .72$). *CONCLUSIONS AND DISCUSSION*—Plantar-flexor peak torque and dorsiflexion ROM are interrelated and appear to be important factors that contribute to ankle plantar-flexor moments and power during walking. This finding suggests that increasing PFPT and dorsiflexion ROM may help decrease gait deviations such as decreased step length and walking speed. When increasing PFPT is not possible, the natural occurrence of limited dorsiflexion ROM may help to maximize ankle moments during walking. Further research is needed to test whether these proposed treatment strategies can have a clinically useful effect.

Cerny K. Vastus medialis oblique/vastus lateralis muscle activity ratios for selected exercises in persons with and without patellofemoral pain syndrome. *Phys Ther*. Aug 1995;75:672–683.

BACKGROUND AND PURPOSE—The purpose of this study was to determine which of selected exercises with and without the feet free to move would enhance vastus medialis oblique muscle (VMO) activity over that of the vastus lateralis muscle (VL) and whether the use of taping would increase VMO activity. *SUBJECTS*—Twenty-one subjects without patellofemoral pain (PFP) syndrome and 10 subjects with PFP syndrome, aged 19 to 43 years ($\overline{X} = 26$, SD = 7), participated. *METHODS*—Subjects were studied for the normalized, integrated electromyographic (IEMG) activity of their VMO, VL, and adductor magnus muscle (subjects without PFP syndrome) and the VMO/VL ratio using wire electrodes. *RESULTS*—One exercise demonstrated greater activation of the VMO over the VL when compared with similar exercises in subjects without PFP syndrome. The mean VMO/VL activity ratio for terminal knee extension was 1.2 (SD = .5) with the hip medially rotated and 1.0 (SD = .4) with the hip laterally rotated. Although subjects reported that patellar taping decreased pain 94% during the step-down exercise, the VMO/VL ratio was not changed. *CONCLUSIONS AND DISCUSSION*—The results suggest that neither exercises purported to selectively activate VMO activity nor patellar taping improve the VMO/VL ratio over similar exercises.

De Deyne PG, Kirsch-Volders M. In vitro effects of therapeutic ultrasound on the nucleus of human fibroblasts. *Phys Ther*. Jul 1995;75:629–634.

BACKGROUND AND PURPOSE—The purpose of this investigation was to examine the cytological effects of therapeutic ultrasound on human fibroblasts. *MATERIALS AND METHODS*—Using an in vitro approach, the number of cells recovered, the morphology of chromosomes, and the presence of mitotic spindles were studied after sonication of human fibroblasts in culture. The ultrasound output had a frequency of 1 MHz and was delivered in a pulse mode of 2 milliseconds on and 8 milliseconds off. Sonication was given for 0, 30, 60, and 90 seconds. *RESULTS*—There was a time-dependent decrease in number of cells recovered, a fourfold increase in

mitotic index in the cells that survived the treatment, and a nearly eightfold increase of chromosomal aberrations with loss of mitotic spindles. *CONCLUSIONS AND DISCUSSION*—The dose-dependent lytic effect of nonthermal ultrasound could result in fractionation of cells, which might facilitate phagocytosis during chronic inflammation. In addition, we observed an increase in chromosomal aberrations and a loss of mitotic spindles as a result of an extremely short ultrasound treatment (30 seconds). Whether these alterations are mutagenic or not warrants further study. It is possible that in our in vitro experiments, the ultrasound received was greater than would occur in a clinical situation.

Scudds RJ, Helewa A, Scudds RA. The effects of transcutaneous electrical nerve stimulation on skin temperature in asymptomatic subjects. *Phys Ther*. Jul 1995;75:621–628.

BACKGROUND AND PURPOSE—Several studies have evaluated the effects of transcutaneous electrical nerve stimulation (TENS) on skin temperature. The results of these studies, however, remain controversial. This study examined the effects of two modes of TENS, compared with a control condition, on skin temperature of the hand and finger. *SUBJECTS*—Twenty-four asymptomatic subjects (23 female, 1 male) with no previous experience with TENS participated. The subjects ranged in age from 19 to 28 years (means = 23.0, SD = 2.44). *METHODS*—All subjects participated in a 4-Hz TENS session, a 100-Hz TENS session, and a control (no TENS) session. Electrodes were placed on the medial and lateral aspects of the dorsal surface of the left hand. Each session consisted of a 60-minute stabilization period, a 30-minute stimulation period, and a 30-minute follow-up period. Hand temperature was measured using infrared thermography, and finger temperature was measured using a skin thermistor. *RESULTS*—Mean hand temperature after low-frequency TENS was 1.69°C warmer than the mean hand temperature following the high-frequency TENS and 1.60°C warmer than after the control condition. No differences in the finger temperature were found among the three conditions. *CONCLUSION AND DISCUSSION*—High-intensity, low-frequency TENS prevented cooling of the hand. High- and low-frequency TENS had no effect on finger temperature.

Costello CT, Jeske AH. Iontophoresis: applications in transdermal medication delivery. *Phys Ther*. Jun 1995;75: 554–563. Review article: 103 refs.

This article presents a review of the literature relating to iontophoresis. This technique has been used in *physical therapy* to introduce ionic medications through the skin, primarily for a local effect. Recently, there has been increased interest in using this technique for the transdermal delivery of medications, both ionic and nonionic. This article includes an overview of the history of iontophoresis and a discussion of the physico-chemical and biological factors affecting iontophoretic drug transfer for both local and systemic effects. Factors affecting skin injury and techniques for optimizing iontophoretic drug delivery through the use of current modulation, electrode construction, and skin permeation enhancers are also discussed. Clinical applications of iontophoresis in physical therapy and the pharmacology of selected medications are presented. Thoughts for future potential uses of this technique and needs for further research are also discussed.

The use of ultrasound as an enhancer for transcutaneous drug delivery: phonophoresis. *Phys Ther*. Jun 1995; 75:539–553. Review article: 95 refs.

Phonophoresis is the use of ultrasound (US) to enhance the delivery of topically applied drugs. The purposes of this article are: 1) to review the basic principles of transcutaneous drug delivery, 2) to summarize the functional anatomy of the skin pertinent to phonophoresis, 3) to outline the physiological principles of US as an enhancer of topically applied drugs, 4) to review the literature on the efficacy of phonophoresis, 5) to discuss the relevance of US as an enhancer of topical drugs in the practice of physical therapy, and 6) to outline areas of needed research. Seventy-five percent of the studies reviewed reported positive effects of US on local subcutaneous drug diffusion, but some systemic effects were reported. This research review indicates that to maximize the clinical effectiveness of phonophoresis: 1) the topical drug (both the drug and the carrying agent) should transmit US; 2) the skin should be pretreated with US, heating, moistening, or shaving; 3) the patient needs to be positioned to maximize circulation during treatment; 4) a dressing that seals the area and prevents the escape of moisture should be applied after treatment; 5) an intensity of 1.5 W/cm2 should be used to capture both the thermal and nonthermal effects of the US; and 6) low-intensity US (0.5 W/cm2) should be used when treating open wounds or acute injuries. Research is needed to clarify what parameters of US will most efficiently facilitate topical drug diffusion, how often and for what duration US should be used to maximize local absorption of drugs, and which topical drugs can most effectively be used for phonophoresis.

WANTED

MOST VALUABLE TRAINER FOR THE TINACTIN TOUGH CASES AWARD

Tinactin®

The Tinactin TOUGH CASES Award honors a winner and a runner-up ATC for outstanding treatment of a person or group of people. The recipient of the training program does not need to be an athlete.

You can submit your own work in treating a TOUGH CASE or submit an entry for a fellow trainer. A TOUGH CASE entry for example, could be managing an individual's long-term rehabilitation, developing an athletic training program in a school, demonstrating the value of athletic training to a community or performing an emergency procedure.

REWARD

The winning athletic trainer will be awarded $1,000 and the runner-up will receive $500.

Winners will be announced in June at the Opening Session of the NATA Annual Meeting in Orlando. Winners will also be featured in the *NATA News*.

HOW TO ENTER

1. Any NATA certified athletic trainer is eligible. Nominate yourself or nominate a colleague!
2. Fill out the entry form included here. →
3. Write a brief, descriptive essay highlighting the TOUGH CASE. The essay should describe how the TOUGH CASE was treated **and** why it was the most effective course of action. Also include results of the treatment and current status of the TOUGH CASE.
4. Feel free to include materials that support the TOUGH CASE.
5. Entries will be judged by Former NATA President Mark Smaha and a panel of five judges. Submissions will be judged on how the case was handled, not on writing ability.
6. Submit your entry form and essay by April 15, 1996.
7. Send to:
   Tough Cases Award
   c/o Porter/Novelli
   303 East Wacker Drive
   Suite 1214
   Chicago, IL 60601

OFFICIAL SPONSOR
National Athletic Trainers' Association

TOUGH CASES ENTRY FORM

Note: Please type or print.

Submitted by

Name of nominee

Organization

Address

City

State Zip Code

Work phone (area code first)

Fax

Was nominee an athletic trainer for this organization when he/she treated this TOUGH CASE?
☐ Yes ☐ No

If not, which organization was he/she affiliated with?

Name of supervisor at the time

Supervisor's telephone number

Date(s) TOUGH CASE was treated

Location and occasion during which TOUGH CASE was treated

Please attach a brief essay to this entry form

New Products

Total Contact Face Shield

The Total Contact Face Shield (T.C.F.S.) is the newest trend in facial protection. Made by MBI Sports Protection Products, Palos Heights, Illinois the "T.C.F.S." is custom made to comfortably fit each individual's unique features. The clear polycarbonate mask uses the total contact principal to maximize surface area in order to disperse force, and relieve risk to the injured area. A padded model is also available for wrestling. For more information, phone: 708-361-3403, FAX: 708-361-4114.

New Closed-Chain Rider

Mettler Electronics announces the new CC Rider™ Closed-Chain Rehabilitation System. The new CC Rider provides a vast range of options for designing closed-chain programs. The CC Rider also eliminates the need for multiple pieces of equipment. The CC Rider's capabilities include bilateral strength measurement; post-surgical rehab with low-weight bearing exercise; and closed-chain rehabilitation with accommodating resistance throughout a full range of motion. For additional information, call 1-800-854-9305.

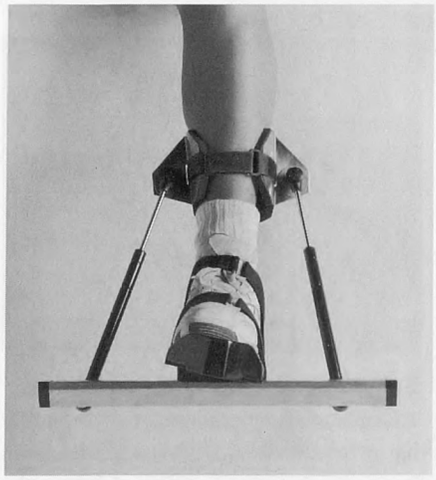
The Ankle Rehab Pump by OrthoDynamics

OrthoDynamics presents the Ankle Rehab Pump. The Ankle Rehab Pump is designed to strengthen and rehabilitate those motions which are most commonly affected by ankle injuries—inversion and eversion.

The ANKLE REHAB PUMP uses hydraulic cylinders, which provide accommodative resistance, like the common home rowing machine. In the early phases of rehabilitation, a person is unable to generate much force and therefore, will compress the cylinders slowly. As rehab progresses, the person generates greater force, and compresses the cylinders at a greater speed. Increased speed requires increased force, and that means increased strength.

The device is non-weight bearing, small and light weight (less than 3 pounds) and portable.

For more information, phone 800-436-7122.



Cramer Introduces New Padding Material

Now there's another padding alternative to foam and felt. Unlike foam or felt which cushion by compressing when a force is applied, Ortho Gel™ cushions viscoelastically. When a force is applied, Ortho Gel flows outward from the point of impact, dissipating the force laterally throughout the material. When the force is removed, the gel's inherent memory returns it to its original shape, ready to cushion the next blow.

The semi-viscous nature of Ortho Gel keeps the shearing action at the top of the material while allowing the material against the skin to remain motionless. That allows athletes with injuries which are more painful than they are serious to return to the action.

Ortho Gel also delivers cold therapy while it protects. When put in the freezer, Ortho Gel stores cold while retaining its viscoelasticity.

Ortho Gel can be used on hip pointers, under shoulder pads, inside shin guards, as doughnuts under tape jobs and just about anywhere else foam or felt padding is used. Ortho Gel comes in three thicknesses and can be cut to any shape. For information, phone 800-255-6621.

Cramer Introduces Sprained Ankle Orthotic

Cramer Products just introduced its Sprained Ankle Orthotic™, a ready-to-use lateral heel wedge.

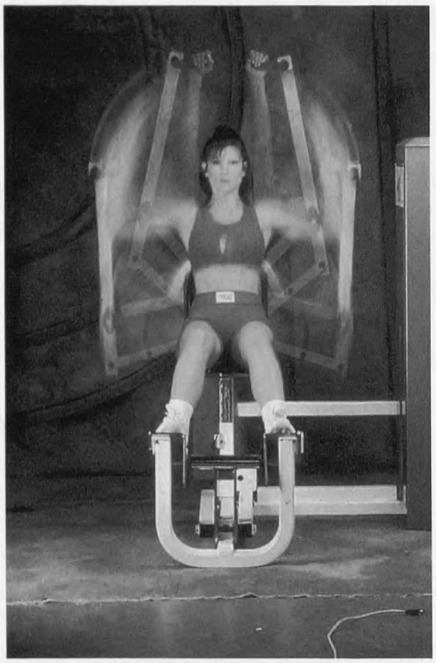
The Sprained Ankle Orthotic is ready to use and provides the optimum amount of lift needed to reduce the likelihood an athlete will inadvertently roll a freshly sprained ankle. It is cast from a resilient polymer and can be cleaned and re-used.

Cramer's Sprained Ankle Orthotic helps reduce the pain and likelihood an athlete will reinjure the ankle by providing the lift necessary to protect against rollover.

For more information, call 1-800-255-6621.

ARCUATE™ Strength Training Machines Break New Ground Through Natural Motion

Pacific Fitness Corporation has introduced ARCUATE™, strength training machines that guide the users through a curved, natural range of motion. The series currently includes a seated row, chest press, shoulder press, and incline press machine.



Instead of the traditional straight line, the patent-pending ARCUATE™ machines guide the user to move in a horizontally curved, "arc-like" direction, mirroring the body's natural motion.

They combine the natural motions experienced in free weight exercise with the efficiency of resistance curves for primary muscle groups and their adjacent muscles and joints.

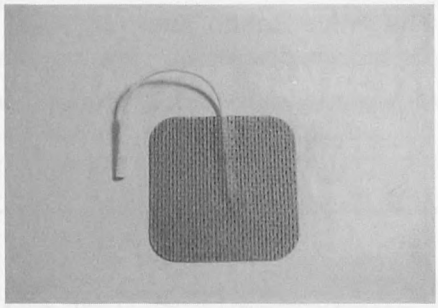
The ARCUATES™ are made of 11 gauge tubular steel, ball-bearing pivots, foam-molded, body-contoured pads and shrouded weight stacks.

For more information, call 800-PAC-FIT2.

PolyStim II™ Electrodes

The Polystim II™ Electrode by Medical Science Products, Inc is a 2″ × 2″ prewired size. It can also be trimmed to size and shape for a particular need.

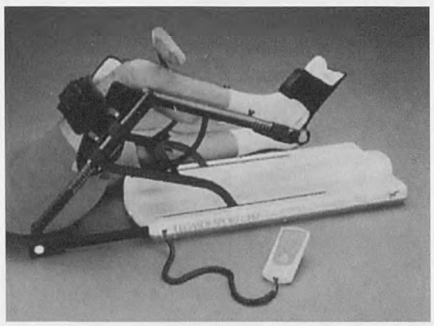
The Polystim II™ reusable electrode carries a flesh-toned surface over a thin conductive, adhesive hydrogel. The durable hydrogel maintains total skin contact without slip-sliding out of position. The electrode construction allows for uniform distribution of the current throughout the electrode. This electrode works for sensitive skin while leaving no residue on the skin's surface. For more information call: 1-800-456-1971.



Sutter Introduces Legasus CPM™

Sutter Corporation has introduced the Legasus CPM™, the home care CPM device that provides full extension of the knee for rehabilitation patients. Part of a new line of lightweight homecare CPM devices, the Legasus reduces recovery time and helps patients achieve a rapid return to full range of motion.

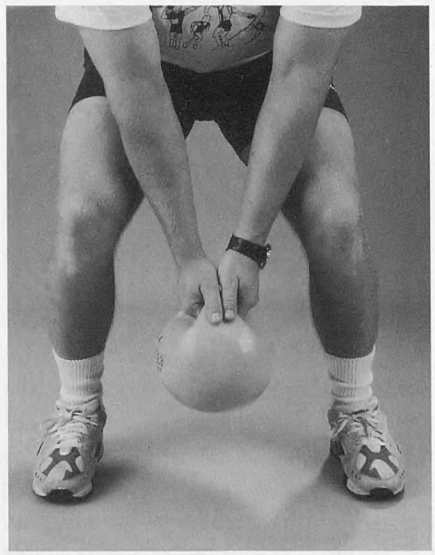
The Legasus has a rigid anterior plate that facilitates full extension. The Legasus helps patients from lapsing into extension lag by extending the leg down to 0°. The anatomical hip joint allows the unit to track the knee's natural range of motion.



Legasus allows tailored CPM therapy that provides up to a 30-second pause in flexion and extension. In addition, the optional patella mobilizer provides proper glide each time the leg goes into extension to help prevent patellar scarring. For additional information, call 800-854-2216.

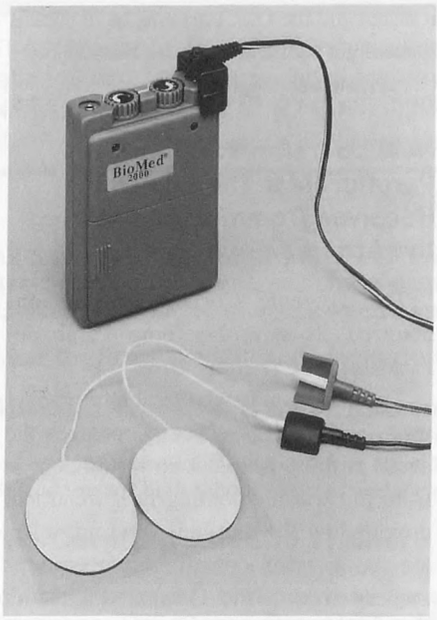
Power Ball from M-F

From M-F's Perform Better Catalog, Power Ball, available in weights 2 lb to 40 lb, is perfect for developing explosive power and ideal for rehabilitation. Comfortable built-in handle allows easy pickup. Throw it underhanded, sidearm, or overhead. Serves as the basis of a great total body development. M-F suggests different weights for speed, endurance, strength, or technique. Will not harm floor. Comes with free instructional video. Priced by weight, for example, 4 lb Power Ball is $27.95. For catalog or information, write M-F Athletic Company, PO Box 8090, Cranston, RI 02920-0090 or call 1-800-556-7464.



BioShield™ Safety Lead Wire

BioMedical Life Systems, Inc introduces the BioShield™ Safety Lead Wires. The Patent Pending BioShield™ Safety Lead Wire eliminates the risk of electrode lead wires being inserted so as to make contact with live parts of a power outlet or separate power cord. The BioShield™ Safety Lead Wire also conforms to the German DIN IEC 601-1 and UL 2601-1 Standards. The 48″ (1.2m) leadwire has positive (red) and (black) pin indicators. For more information, please call (800) 726-8367.



New Donjoy "MC Walker™" Offers Restricted Range-of-Motion Control

Smith & Nephew DonJoy has introduced the MC Walker™, a low-cost, range-of-motion control walker with fixed settings to offer support for lower leg and ankle injuries while protecting against overextension.

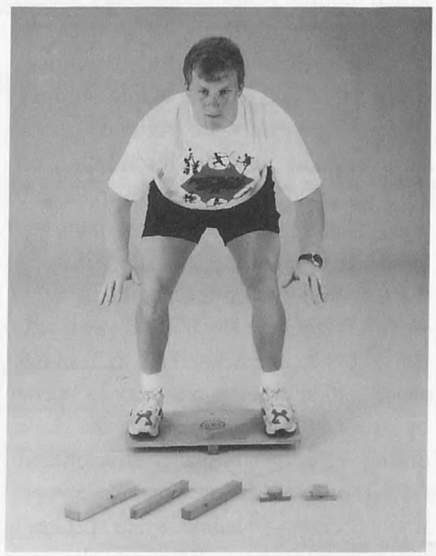
To help promote patient mobilization without the use of a cast or crutches, the MC Walker™ features adjustable cinch screws designed to eliminate any possible micro movement of the stabilizing upright during normal use. This enables the patient to comply with a physician's prescribed movement allowances. Cinch screw settings can be adjusted by hand with a dial and uprights that will hold a fixed 90° angle when both pins are set at 0°. The range-of-motion control also has settings between 45° plantar-flexion and 30° dorsi-flexion. Sturdy, rigid, malleable uprights may be custom-formed to individual patient requirements.

"Because it's comfortable and easy to apply and adjust, patients are more likely to wear the MC Walker™ and get the support they need to heal properly," said Chuck Bastyr, vice president of marketing and business development. "In addition, the MC Walker™ is a cost-effective solution for protected range-of-motion control."

Built with lightweight materials and a breathable liner, the MC Walker's low-profile design includes a Non-Skid Sole and Rocker Bottom shoe which allow for near normal stature and gait. The brace is suitable for treatment of sprains, strains, stable ankle fractures, Achilles tendon repair and stress fractures of the lower leg and ankle. For more information on the MC Walker™ call DonJoy at (800) 336-6569.

Balance Board From M-F

For under $50.00 in the new M-F Perform Better Catalog, you will find this Balance Board package with five interchangeable fulcrums that allow you to change (increase or decrease) the difficulty on a plane or angle up to 360°. Ideal for balance, stability and agility training and therapy. To order or for a 1995 Perform Better Catalog, call Toll-Free 1-800-556-7464 or fax your request, Toll-Free 1-800-682-6950.



OPTP Introduces Janda's Program

OPTP introduces Vladimir Janda's program of therapy for muscle imbalances, inhibition, and or tightness: Specially designed progressive wooden "balance" tools are used for chronic pain treatment. In this program, patients progress from easiest to most difficult levels of treatment, by using successive balance and proprioception challenges, thereby improving stabilization of the pelvis and overall body posture.

The *Wooden Uniplane Rocker* provides sensory motor challenges in two planes. Movement is restricted, making

the Uniplane Rocker the first step in movement retraining.

The video programs "Muscle Length Assessment" and "Sensory Motor Stimulation" demonstrate Janda's initial muscle assessment techniques and later use of the balance devices.

The products and the videos are available exclusively from OPTP. For more information call OPTP at 1-800-367-7393.

Cobra Speed Master

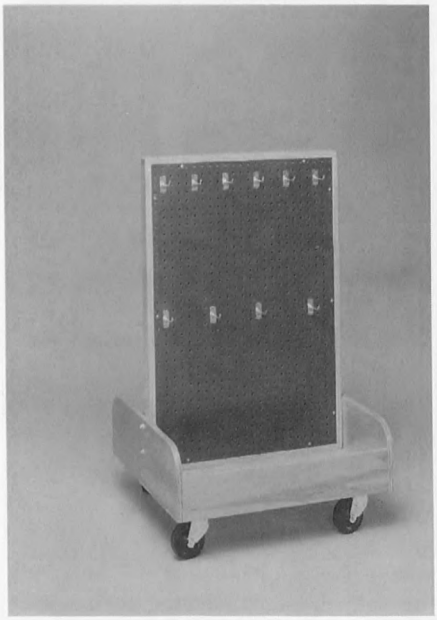
From M-F's Kytec collection, as featured in their '95 Perform Better Catalog, the Cobra Speed Master™, ideal to practice "blasting off the mark." Also great to develop first step quickness. Two 8′ super stretch cords attach to a 5″ padded waist belt with the snap hook connected to a sturdy object. Used in athletic training and valuable as a therapy aid. Under $50.00 in the M-F Perform Better Catalog. For information or for a catalog, call Toll-Free 1-800-556-7464 or fax Toll-Free 1-800-682-6950.

Small Cuff Weight Cart

Introducing the Model #783 Small Cuff Weight Cart from Bailey Manufacturing Company. The wood frame sits upon four 4″ swivel casters, which provides stability and ease of movement. Each cart comes with 30 pegs that will not pull away from the frame when weight is placed upon them.

The weight capacity for Model #783 is 200 lbs.

For more information, call 1-800-321-8372.



Power Fitness Chute™

What's different about this Power Fitness Chute™? M-F Athletic points out it is the only chute that offers easily adjustable resistance. You can run forward or backward, and it is great for contrast running. The runner can begin a run with resistance then release the chute and feel a sudden burst of speed resulting in an increase of stride frequency. This new generation of Power Fitness Chute flies higher and steadier. In small, medium, large and extra-large sizes, and priced from only $70. Call Toll-Free 1-800-556-7464 for chute information or a 1995 M-F Perform Better Catalog, or fax Toll-Free 1-800-682-6950.

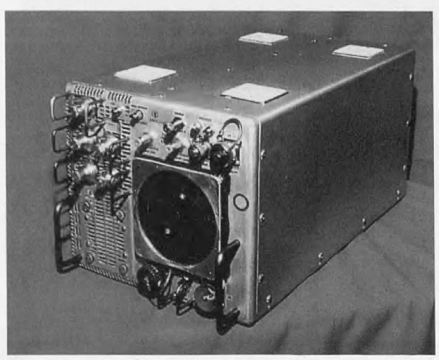
MedGraphics Cardio System Monitors Russian Astronauts

The Russian spacecraft, Spektr, launched from Baikonur, Russia, on May 19 delivered a cardiopulmonary exercise system to Mir, the Russian space station, on May 26. The cardiopulmonary diagnostic system, manufactured by Medical Graphics Corporation of St. Paul, Minnesota, will be used by an astronaut and two cosmonauts in life science experiments and research during their stay on Mir.

The cardiopulmonary diagnostic system is a modified version of the commercially available CPX/D gas analyzer which monitors cardiopulmonary fitness. The space team is using the system daily to measure their heart rates, resting metabolic rates, and cardiac output noninvasively. The results are compared to an earth baseline, and the information can be used to adjust diet and exercise routines to maintain fitness. Astronauts tend to lose muscle tone and bone mass due to the microgravity environment.

The MedGraphics CPX/D was redesigned to be compact enough to fit in tight space station quarters and easy to operate by astronauts who experience the disorienting effects of space environment. CPX/D uses Medical Graphics corporation's $Breeze_{EX}$™ software that operates in a Russian language, Windows-like environment that is icon and menu driven.

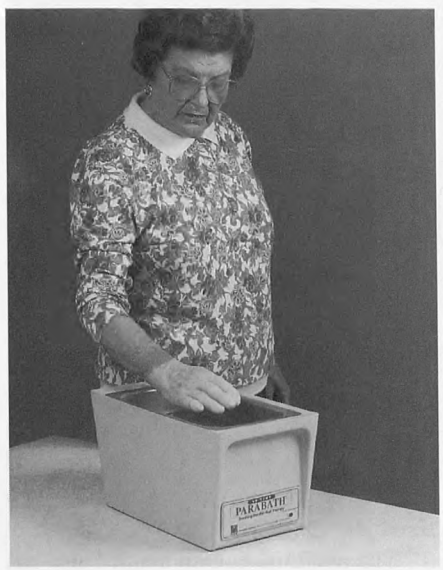
NASA will use another modified CPX/D system on the U.S. space shuttle, Atlantis, scheduled to dock with Mir in June. The CPX/D systems used in the Russian and the U.S. missions have passed space flight certification by the Russian State Commission and NASA, respectively.



New Lo-Temp Parabath® Paraffin Heat Therapy Unit Receives Commendation From the Arthritis Foundation

The Hygenic Corporation has announced its new Lo-Temp Parabath® Paraffin Heat Therapy Unit.

The new Lo-Temp Parabath® model was developed specifically to meet the needs of those people who would benefit from the warm, soothing heat treatment provided by the unit but could not tolerate the warmer operating temperatures associated with the Original Parabath® unit. In addition to people with arthritis, the Lo-Temp Parabath® unit is recommended by clinicians for use with burn patients, as well as many pediatric and geriatric patients.



A portable, lightweight unit, the easy-to-use Lo-Temp Parabath® Paraffin Heat Therapy Unit is ideal for both clinic and home use. The unit features a durable stainless steel tank inside an insulated outer housing. After plugging in the unit and placing two 3-lb. blocks of paraffin into the bath, the unit will melt the paraffin and reach proper operating temperature in approximately five hours.

Paraffin refills and accessories such as mobile stands, mitts and boots are available for use with the Lo-Temp Parabath® system. For more information, phone (800) 321-2135.

NATA Promotional Materials Available

The National Athletic Trainers' Association (NATA) offers a variety of information designed to promote and advance the athletic training profession. To place an order for brochures or videos, simply fill out the request form and mail or fax it to the NATA national office at (214) 637-2206.

Sorry, but because of the tremendous volume of telephone calls, we cannot adequately service telephone orders.

BROCHURES

As a membership benefit, the NATA will send you a total of 25 brochures at no cost. Brochures must be ordered in increments of 5. You may order any combination that totals 25—for example, 10 of one brochure and 5 each of the other three.

After the first 25, additional brochures cost $5.00 per 25.

Athletic Training Career Information

Six-page brochure introducing the athletic training profession. It explains in detail what athletic trainers do, educational requirements for athletic training, and basic qualifications for certification. Geared toward high school students and their parents, but is also an excellent promotional piece.

The Certified Athletic Trainer

Describes the athletic training profession and why athletic trainers are such an important asset to an athletic program. It also provides general information about the National Athletic Trainers' Association. This 10-page, four-color brochure is targeted to parents, school administrators and the media.

Minimizing the Risk of Injury in High School Athletics

General guidelines for reducing the risk of injury in high school sports. Specifically targets seven sports and provides tips for preventing injuries in those particular activities. Written for coaches, athletic directors, administrators, parents and students.

The NATA Job Referral Services

Describes how to use the NATA Job Hotline, Bulletin Board and Job Referral List. Also shows employers how to get an opening listed.

VIDEOS

Athletic Trainers: Treating Athletes Better

11 minutes in length and available in VHS format only. In-depth explanation of the role an athletic trainer plays in the health care system. Covers the domains of athletic training and explains the educational requirements needed to become an ATC. ***Cost: $10***

The Dennis Byrd Address

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Current Literature

Clint Thompson, MS, ATC

ANKLE

Valentine BC 2nd, Buoye SF, Naples JJ. Talar fracture/dislocation in the adolescent patient. *J Foot Ankle Surg.* July–Aug 1995;34:379–383. Review article: 11 refs.

Munk B, Holm-Christensen K, Lind T. Long-term outcome after ruptured lateral ankle ligaments. A prospective study of three different treatments in 79 patients with 11-year follow-up. *Acta Orthop Scand.* Oct 1995;66:452–454.

Sitler MR, Horodyski M. Effectiveness of prophylactic ankle stabilisers for prevention of ankle injuries. *Sports Med.* Jul 1995;20:53–57. Review article: 24 refs.

Corbett M, Levy A, Abramowitz AJ, Whitelaw GP. A computer tomographic classification system for the displaced intraarticular fracture of the os calcis. *Orthopedics.* 1995;18:705–710.

Stromsoe K, Hoqevold HE, Skjeldal S, Alho A. The repair of a ruptured deltoid ligament is not necessary in ankle fractures. *J Bone Joint Surg [Br].* 1995;77B:920–921.

Hartford JM, Gorczyca JT, McNamara JL, Mayor MB. Tibiotalar contact area. Contribution of posterior malleolus and deltoid ligament. *Clin Orthop.* Nov 1995;182–187.

Mesgarzadeh M, Schneck CD, Tehranzadeh J, Chandnani VP, Bonakdarpour A. Magnetic resonance imaging of ankle ligaments. Emphasis on anatomy and injuries to lateral collateral ligaments. *Magn Reson Imaging Clin N Am.* Feb 1994;2:39–58. Review article: 48 refs.

Anis AH, Stiell IG, Stewart DG, Laupacis A. Cost-effectiveness analysis of the Ottawa Ankle Rules. *Ann Emerg Med.* Oct 1995;26:422–428.

Stiell I, Wells G, Laupacis A, et al. Multicentre trial to introduce the Ottawa ankle rules for use of radiography in acute ankle injuries. Multicentre Ankle Rule Study Group. *BMJ.* Sep 2, 1995;311:594–597.

Lucchesi GM, Jackson RE, Peacock WF, Cerasani C, Swor RA. Sensitivity of the Ottawa rules. *Ann Emerg Med.* Jul 1995;26:1–5.

Stanish WD. Lower leg, foot, and ankle injuries in young athletes. *Clin Sports Med.* Jul 2, 1995; 14:651–668. Review article: 71 refs.

McCaskie AW, Gale DW, Finlay D, Allen MJ. Chronic ankle instability: the value of talar tilt under general anaesthesia. *Br J Sports Med.* Jun 1995;29:103–104.

Regis D, Montanari M, Magnan B, Spagnol S, Bragantini A. Dynamic orthopaedic brace in the treatment of ankle sprains. *Foot Ankle Int.* Jul 1995;16:422–426.

Dreiser RL, Roche R, De Sahb R, Thomas F, Leutenegger E. Flurbiprofen local action transcutaneous (LAT): clinical evaluation in the treatment of acute ankle sprains. *Eur J Rheumatol Inflamm.* 1994;14:9–13.

Ogilvie-Harris DJ, Gilbart M. Treatment modalities for soft tissue injuries of the ankle: a critical review. *Clin J Sport Med.* Jul 1995;5:175–186.

Nigg BM, Nigg CR, Reinschmidt C. Reliability and validity of active, passive and dynamic range of motion tests. *Sportverletz Sportschaden.* Jun 1995;9:51–57.

Tomaro JE, Butterfield SL. Biomechanical treatment of traumatic foot and ankle injuries with the use of foot orthotics. *J Orthop Sports Phys Ther.* Jun 1995;21:373–380. Review article: 32 refs.

Veltri DM, Pagnani MJ, O'Brien SJ, Warren RF, Ryan MD, Barnes RP. Symptomatic ossification of the tibiofibular syndesmosis in professional football players: a sequela of the syndesmotic ankle sprain. *Foot Ankle Int.* May 1995;16:285–290.

Anderson DL, Sanderson DJ, Hennig EM. The role of external nonrigid ankle bracing in limiting ankle inversion. *Clin J Sport Med.* 1995;5: 18–24.

Sandmeier RH, Renstrom PA. Ankle arthroscopy. *Scand J Med Sci Sports.* Apr 1995;5:64–70. Review article: 51 refs.

Marder RA. Current methods for the evaluation of ankle ligament injuries. *Instr Course Lect.* 1995;44:349–357. Review article: 58 refs.

Bernstein RM. Spontaneous rupture of the tibialis anterior tendon. *Am J Orthop.* Apr 1995;24: 354–356.

Fitzgerald J, Michael E. Protocol for lower extremity trauma. *J Foot Ankle Surg.* Jan–Feb 1995;34:2–11.

Christodoulou G, Korovessis P, Giarmenitis S, Dimopoulos P, Sdougos G. The use of sonography for evaluation of the integrity and healing process of the tibiofibular interosseous membrane in ankle fractures. *J Orthop Trauma.* Apr 1995;9:98–106.

Jerosch J, Hoffstetter I, Bork H, Bischof M. The influence of orthoses on the proprioception of the ankle joint. *Knee Surg Sports Traumatol Arthrosc.* 1995;3:39–46.

Lentell G, Bass B, Lopez D, McGuire L, Sarrels M, Snyder P. The contributions of proprioceptive deficits, muscle function, and anatomic laxity to functional instability of the ankle. *J Orthop Sports Phys Ther.* Apr 1995;21:206–215.

Brosky T, Nyland J, Nitz A, Caborn DN. The ankle ligaments: consideration of syndesmotic injury and implications for rehabilitation. *J Orthop Sports Phys Ther.* Apr 1995;21:197–205. Review article: 69 refs.

Tropp H, Norlin R. Ankle performance after ankle fracture: a randomized study of early mobilization. *Foot Ankle Int.* Feb 1995;16:79–83.

Roberts CS, DeMaio M, Larkin JJ, Paine R. Eversion ankle sprains. *Orthopedics.* Mar 1995; 18:299–304. Review article: 31 refs.

van Holsbeeck M, Powell A. Ankle and foot. *Clin Diagn Ultrasound.* 1995;30:221–37. Review article: 14 refs.

Macpherson K, Sitler M, Kimura I, Horodyski M. Effects of a semirigid and softshell prophylactic ankle stabilizer on selected performance tests among high school football players. *J Orthop Sports Phys Ther.* Mar 1995;21:147–152.

Verhagen RA, de Keizer G, van Dijk CN. Long-term follow-up of inversion trauma of the ankle. *Arch Orthop Trauma Surg.* 1995;114:92–96.

Joshi A. Acute ankle and foot injury—guidelines for radiography. *West J Med.* Feb 1995;162:152.

Clark TW, Janzen DL, Ho K, Grunfeld A, Connell DG. Detection of radiographically occult ankle fractures following acute trauma: positive predictive value of an ankle effusion. *AJR Am J Roentgenol.* May 1995;164:1185–1189.

Zecher SB, Leach RE. Lower leg and foot injuries in tennis and other racquet sports. *Clin Sports Med.* Jan 1995;14:223–239. Review article: 24 refs.

Chesworth BM, Vandervoort AA. Comparison of passive stiffness variables and range of motion in uninvolved and involved ankle joints of patients following ankle fractures. *Phys Ther.* Apr 1995;75:253–261.

Campbell DG, Menz A, Isaacs J. Dynamic ankle ultrasonography. A new imaging technique for acute ankle ligament injuries. *Am J Sports Med.* Nov–Dec 1994;22:855–858.

Bennell KL, Goldie PA. The differential effects of external ankle support on postural control. *J Orthop Sports Phys Ther.* Dec 1994;20:287–295.

Liu SH, Jacobson KE. A new operation for chronic lateral ankle instability. *J Bone Joint Surg [Br].* Jan 1995;77B:55–59.

Bullock-Saxton JE, Janda V, Bullock MI. The influence of ankle sprain injury on muscle activation during hip extension. *Int J Sports Med.* Aug 1994;15:330–334.

Marcus RE, Pfister ME. The enigmatic diagnosis of posterior tibialis tendon rupture. *Iowa Orthop J.* 1993;13:171–177.

Christensen JC, Driscoll HL, Tencer AF. 1994 William J. Stickel Gold Award. Contact characteristics of the ankle joint. Part 2. The effects of talar dome cartilage defects. *J Am Podiatr Med Assoc.* Nov 1994;84:537–547.

Liu SH, Jason WJ. Lateral ankle sprains and instability problems. *Clin Sports Med.* Oct 1994; 13:793–809.

Seto JL, Brewster CE. Treatment approaches following foot and ankle injury. *Clin Sports Med.* Oct 1994;13:695–718. Review article: 38 refs.

Campbell J, Dunn T. Evaluation of topical ibuprofen cream in the treatment of acute ankle sprains. *J Accid Emerg Med.* Sep 1994;11:178–182.

Squillace SP, Slawson DC. Guidelines for managing ankle injuries: the Ottawa ankle rules. *J Fam Pract.* Dec 1994;39:593–594.

D'Souza D. Track and field athletics injuries—a one-year survey. *Br J Sports Med.* Sep 1994;28: 197–202.

Ogilvie-Harris DJ, Reed SC. Disruption of the ankle syndesmosis: diagnosis and treatment by arthroscopic surgery. *Arthroscopy.* Oct 1994;10: 561–568.

Steinbronn DJ, Bennett GL, Kay DB. The use of magnetic resonance imaging in the diagnosis of stress fractures of the foot and ankle: four case reports. *Foot Ankle Int.* Feb 1994;15:80–83.

Holmer P, Sondergaard L, Konradsen L, Nielsen PT, Jorgensen LN. Epidemiology of sprains in the lateral ankle and foot. *Foot Ankle Int.* Feb 1994;15:72–74.

ENVIRONMENTAL CONDITIONS

Thein LA. Environmental conditions affecting the athlete. *J Orthop Sports Phys Ther.* Mar 1995;21:158–171. Review article: 44 refs.

Lloyd EL. ABC of sports medicine. Temperature and performance. I: Cold. *BMJ.* Aug 20–27 1994;309:531–534. Review article: 0 refs.

Tom PA, Garmel GM, Auerbach PS. Environment-dependent sports emergencies. *Med Clin North Am.* Mar 1994;78:305–325. Review article: 72 refs.

Shephard RJ. Metabolic adaptations to exercise in the cold. An update. *Sports Med.* Oct 1993; 16:266–289. Review article: 256 refs.

IONTOPHORESIS

Kamath SS, Gangarosa LP Sr. Electrophoretic evaluation of the mobility of drugs suitable for iontophoresis. *Methods Find Exp Clin Pharmacol.* May 1995;17:227–232.

Singh P, Anliker M, Maibach HI. Facilitated drug delivery during transdermal iontophoresis. *Curr Probl Dermatol.* 1995;22:184–188.

Singh J, Singh S. Transdermal iontophoresis: effect of penetration enhancer and iontophoresis on drug transport and surface characteristics of human epidermis. *Curr Probl Dermatol.* 1995; 22:179–183.

Kellogg DL Jr, Pergola PE, Piest KL, et al. Cutaneous active vasodilation in humans is mediated by cholinergic nerve cotransmission. *Circ Res.* Dec 1995;77:1222–1228.

De Koninck Y, Salter MW, Henry JL. Substance P released endogenously by high-intensity sensory stimulation potentiates purinergic inhibition of nociceptive dorsal horn neurons induced by peripheral vibration. *Neurosci Lett.* Jul 18, 1994; 176:128–132.

Yu D, Gordon FJ. A simple method to improve the reliability of iontophoretic administration of tracer substances. *J Neurosci Methods.* Jun 1994;52:161–164.

NECK

Collins JD, Shaver ML, Disher AC, Miller TQ. Compromising abnormalities of the brachial plexus as displayed by magnetic resonance imaging. *Clin Anat.* 1995;8:1–16.

Watson CJ, Schenkman M. Physical therapy management of isolated serratus anterior muscle paralysis. *Phys Ther.* Mar 1995;75:194–202.

Porcellini G, Campi F, Brunetti E. Tears of the rotator cuff associated with neurologic disorders: a description of two cases. *Chir Organi Mov.* Jul–Sep 1994;79:321–323.

Duthel R, Tudor C, Motuo-Fotso MJ, Brunon J. Cervical root compression by a loop of the vertebral artery: case report. *Neurosurgery.* Jul 1994;35:140–142.

Sprung C, Fabian A. Pitfalls in computed tomography of the cervical and lumbar spine. *Neurosurg Rev.* 1994;17:19–28.

Veiersted KB, Westgaard RH, Andersen P. Electromyographic evaluation of muscular work pattern as a predictor of trapezius myalgia. *Scand J Work Environ Health.* Aug 1993;19:284–290.

Veiersted KB, Westgaard RH. Development of trapezius myalgia among female workers performing light manual work. *Scand J Work Environ Health.* Aug 1993;19:277–283.

Stav A, Ovadia L, Sternberg A, Kaadan M, Weksler N. Cervical epidural steroid injection for cervicobrachialgia. *Acta Anaesthesiol Scand.* Aug 1993;37:562–566.

Levoska S, Keinanen-Kiukaanniemi S. Active or passive physiotherapy for occupational cervicobrachial disorders? A comparison of two treatment methods with a 1-year follow-up. *Arch Phys Med Rehabil.* Apr 1993;74:425–430.

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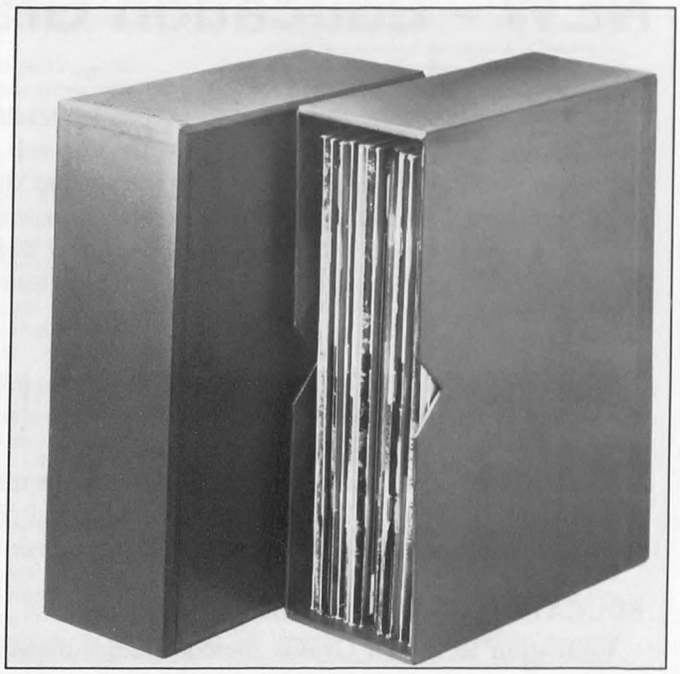

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(Revised April 1995)

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    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.
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Answers to December '95 CEU Quiz
Volume 30, Number 4

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❑ Other (please specify) _____

INSTRUCTIONS

1. Carefully read the articles in this issue.
2. Photocopy this page.
3. Record your answers below by darkening the appropriate letter of your answer.
4. Mail with $20 fee (check or money order only payable to **Indiana State University**) postmarked by May 15, 1996 to:

   JAT— CEU Quiz
   Athletic Training Department
   Indiana State University
   Terre Haute, IN 47809

CEU Quiz Evaluation

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

Please add any suggestions on how to improve the CEU Quiz on the back of this form when you are finished.

RECORD ANSWERS HERE - Darken the appropriate letter. Example: 1 a ● c d e

1	a	b	c	d	e	6	a	b	c	d	e	11	a	b	c	d	e
2	a	b	c	d	e	7	a	b	c	d	e	12	a	b	c	d	e
3	a	b	c	d	e	8	a	b	c	d	e	13	a	b	c	d	e
4	a	b	c	d	e	9	a	b	c	d	e	14	a	b	c	d	e
5	a	b	c	d	e	10	a	b	c	d	e	15	a	b	c	d	e

MARK ANSWERS ON PREVIOUS PAGE.

1. The Athletic Training Action programs use which type of instruction to help students prepare for the NATA certification exam?
   a. Application
   b. Simulation
   c. Video
   d. Oral/practical
   e. None of the above

2. Patellar tendinitis is a common overuse injury affecting many volleyball and baseball players.
   a. True
   b. False

3. Occlusive dressings:
   a. have a lower infection rate.
   b. are viral barriers.
   c. are associated with faster wound healing and less pain than gauze dressings.
   d. All of the above.
   e. b and c only.

4. A study of spearing in high school football before and after the 1976 rule change banning spearing revealed that:
   a. the 1976 rule change had a favorable impact on the incidence of spearing.
   b. running back and ball carrier spearing did not change.
   c. concurrent tackler spearing increased after the rule change.
   d. independent tackler and defensive linemen spearing increased.
   e. both a and c.

5. Hydrogen peroxide has drawbacks when used to cleanse and disinfect a wound:
   a. only when it is used under pressure with a syringe.
   b. due to its toxicity to human keratinocytes.
   c. because it interacts with the enzyme catalase.
   d. All of the above.
   e. b and c only.

6. Athletic trainers can educate athletes about breast and testicular cancer by:
   a. beginning an educational program with the preseason physical exam.
   b. holding both team and individual educational sessions
   c. exhibiting pamphlets and/or posters in the athletic training centers and locker rooms.
   d. obtaining free educational materials from the American Cancer Societies or National Cancer Institute and disseminating the information.
   e. All of the above.

7. For entry-level athletic trainers with a bachelor's degree in 1994,
   a. the highest salaries were in hospital/clinics.
   b. the highest salaries were in high schools.
   c. the highest salaries were in colleges/universities.
   d. the lowest salaries were in hospitals/clinics.
   e. None of the above.

8. Which of the following areas did surveyed athletic trainers counsel in the most?
   a. Sexual issues
   b. Injury rehabilitation
   c. Racial issues
   d. Suicide
   e. Alcohol problems

9. A survey of proper wound care management showed that:
   a. most athletic trainers primarily used the wet-to-dry method to debride a wound.
   b. most athletic trainers primarily used irrigation to debride a wound.
   c. most athletic trainers primarily used soaks to debride a wound.
   d. most athletic trainers used a combination of a, b, and c to debride a wound.
   e. most athletic trainers used povidone-iodine to debride a wound.

10. In the case of the football player with a femoral stress fracture, the initial signs and symptoms of the leg injury indicated which of the following?
    a. Hip flexor strain
    b. Femoral fracture
    c. Quad contusion
    d. Rectus femoris strain
    e. None of the above

11. Back problems are most often caused by:
    a. Trauma
    b. Mechanical problems
    c. Congenital defects
    d. All of the above
    e. Two of the above

12. Which of the following cannot be done while performing a search on a computer database?
    a. Limiting publication years
    b. Truncation
    c. Searching multiple key terms
    d. Eliminating studies performed on animal populations
    e. None of the above

13. Cooling the knee joint for 20 minutes has an adverse effect on knee proprioception.
    a. True
    b. False

14. Before treating an athlete for sural nerve entrapment, the athletic trainer must first rule out:
    a. Disk herniation
    b. Peripheral venous thrombosis
    c. Diabetic-related neuropathy
    d. Only a and b
    e. All of the above

15. Treatment for bilateral navicular stress fractures includes:
    a. Gradual weight bearing
    b. Manual resistance exercises
    c. Tubing exercises
    d. Semirigid orthotics
    e. All of the above

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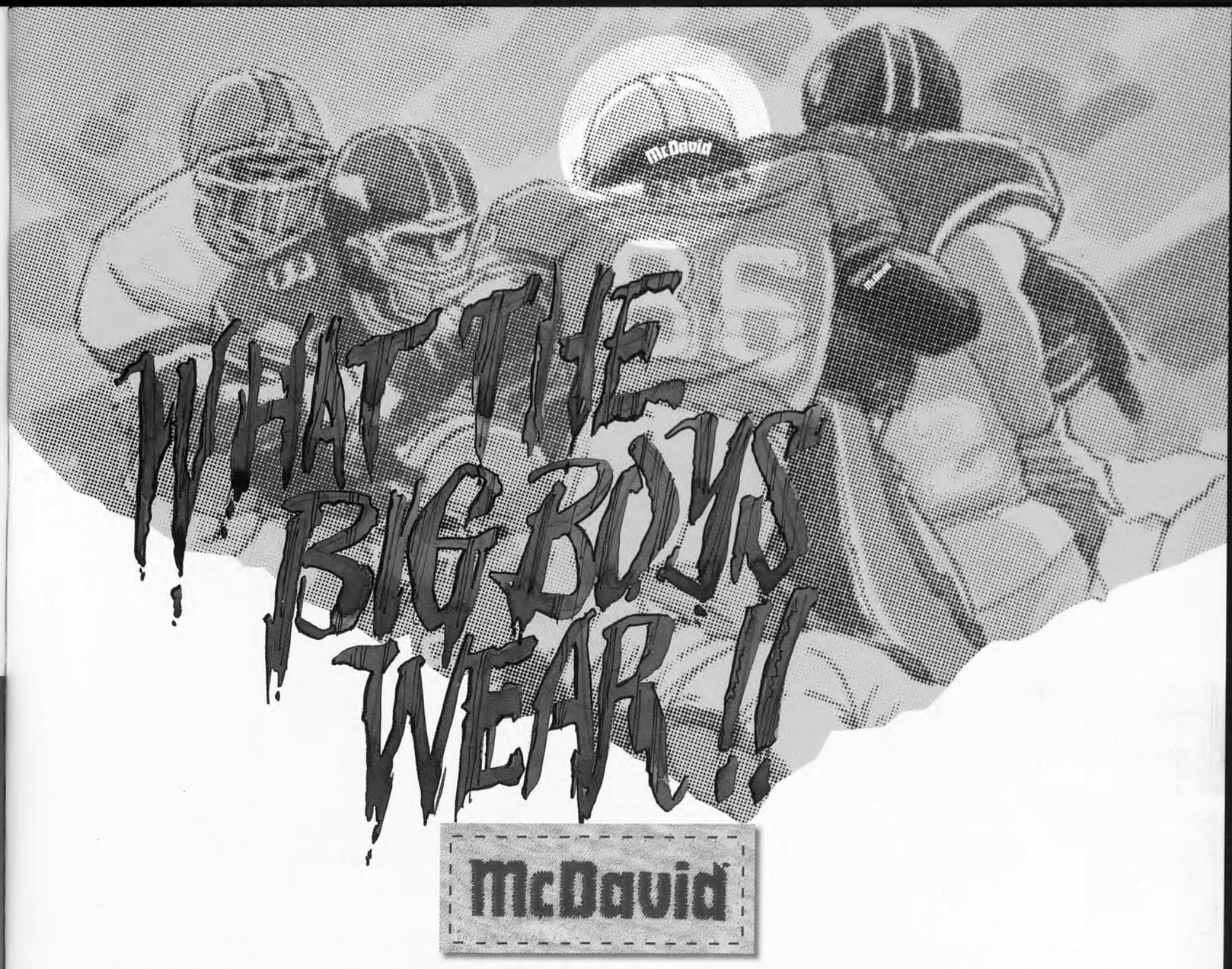

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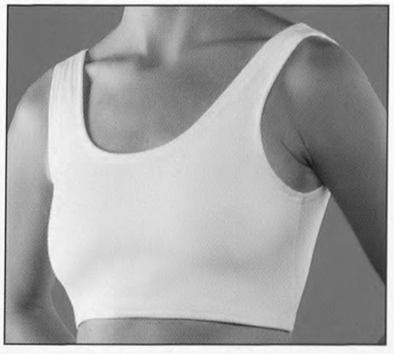

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