JOURNAL OF ATHLETIC TRAINING

VOLUME 30

• NUMBER 2

• JUNE 1995



Official Publication of The National Athletic Trainers' Association

Pro is proud to introduce a revolutionary new functional ACL brace designed for todays' changing market conditions.

The new KS 5 (patient pending) is designed to inhibit tibial translation. As tested, the KS 5 demonstrated significant limitations of tibial translation through 20, 30 and 40 pounds of force (testing performed by an independent research laboratory). The KS 5 was also found to significantly enhance proprioception through both flexion and extension. At the same time it was found that the KS 5 does not inhibit functional capabilities relative to strength, balance and function. Weighing less than 11 ounces complete, the majority test subjects felt their test performance was enhanced while wearing the KS 5. Designed to fit as an "off the shelf" unit the KS 5 will fit either right or left leg. It is easily sized by simply measuring the mid knee circumference. The KS 5 comes standard with a neoprene sleeve suspension. A non-neoprene suspension system is available as an option. At less than 11 ounces the KS 5 is perfect for grade 2 and 3 sprains, post injury use, hyperextension protection, all day wear or for the recreational athlete.

(Not recommend for heavy contact sports such as football). Priced to meet the needs of today's marketplace at



JOURNAL OF ATHLETIC TRAINING

Official Publication of

The National Athletic Trainers' Association

Volume 30, Number 2, June

Editor-In-Chief	Ken Knight, PhD, ATC Indiana State University Terre Haute, IN 47809		Richard Ray, EdD, ATC Hope College Holland, MI 49423	Advertising Manager	Paula Jacobs 1507 Woodward Ave. Lakewood, OH 44107
Consulting Editor	Steve Yates, MEd, ATC Sports Medicine Unit Bowman Gray School of Medicine		Clint Thompson, MS, ATC NE Missouri State University Kirksville, MO 63501	Production Manager	(216) 221-1007 Rebecca S. Gault Cadmus Journal Services
Associate	Wake Forest University Winston-Salem, NC 27109 Craig Denegar PhD ATC PT	Assistant Editor	Janet Brown, MA Indiana State University Terre Haute IN 47809	Editorial Office	Indiana State University Arena C7
Editors	Slippery Rock University Slippery Rock, PA 16057-1326	Editorial Assistants	Mark Casterline, ATC Steve Gruenewald, ATC		Terre Haute, IN 47809 (812) 237-2348 (812) 237-4338 Fax
Chris Ingersoll, PhD, ATC Sha Indiana State University Ind Terre Haute, IN 47809-1001 Ter		Shawn Osowski, LAT Indiana State University Terre Haute, IN 47809	Business	E-mail: PMJAT@SCIFAC.INDSTATE.EDU Ron Cunningham	
	Brent Mangus, EdD, ATC UNLV Las Vegas, NV 89154	Statistical Consultant	Richard Tandy, PhD UNLV Las Vegas, NV 89154	Unice	Dallas, TX 75247 (214) 637-6282 (214) 637-2206 Fax

Editorial Board

Marty Bradley, MS, ATC Old Dominion University Norfolk, VA 23529-0197

Deloss Brubaker, EdD, ATC Life College Marietta, GA 30060

William Buckley, PhD, ATC Pennsylvania State University University Park, PA 16802

Rich Deivert, PhD, ATC The Lipscomb Clinic Foundation for Research & Education, Inc Nashville, TN 37205

Katie Grove, PhD, ATC Indiana University Bloomington, IN 47405

Michael Harland, MS, ATC Franklin Middle School Wheaton, IL 60188-3921

Rod A. Harter, PhD, ATC Oregon State University Corvallis, OR 97331

Peggy Houglum Gardena Industrial Medicine Gardena, CA 90247 Dan Libera, MS, ATC University of Northern Colorado Greeley, CO 80639

Mark Merrick, MA, ATC Northeast Physical Therapy Center Brookfield, CT 06804

Phil Mateja, EdD, ATC Eastern Fine Paper, Inc. Brewer, ME 04412

Bob Moore, PhD, PT, ATC San Diego State University San Diego, CA 92123

Dave Perrin, PhD, ATC University of Virginia Charlottesville, VA 22903

James Rankin, PhD, ATC University of Toledo Toledo, OH 43606-3390

Kent Scriber, EdD, PT, ATC Ithaca College Ithaca, NY 14850

Deb Strait, MS, ATC South Eugene High School Eugene, OR 97403 Michael Voight, MEd, RPT, ATC University of Miami Coral Gables, FL 33146

Frank Walters, PhD, ATC Washington, DC, Public Schools Washington, DC 20019

Tom Weidner, PhD, ATC Ball State University Muncie, IN 47306

Gary Wilkerson, EdD, ATC Biokinetics Inc. Paducah, KY 42001

Bill Wissen, MS, ATC Hastings High School Alief, TX 77411

Kenneth Wright, DA, ATC University of Alabama Tuscaloosa, AL 35487-0312

Donald-Ray Zylks, PhD, ATC South Texas Sports Medicine Center Corpus Christi, TX 78411

The Journal of Athletic Training 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. The views and opinions in the Journal of Athletic Training are those of the authors and are not necessarily of the National Athletic Trainers' Association, Inc. (ISSN 0 160 8320). All rights reserved. Printed in U.S.A.

The DonJoy Legend Continues.



Patient-Ready Fitting

The "Patient-Ready Fitting" system developed for the Legend offers uniquely formed bars and cuffs, sized and shaped to correlate with each of the seven available sizes. The measurements of 50,000 legs were digitized and a computer model was developed to design a truly anatomically configured functional off-the-shelf knee brace. This means that the Legend will fit most patients directly out of the box.

The Four Points of Leverage

A dynamic bracing system which suppresses abnormal anterior drawer, DonJoy's patented Four Points of Leverage system features a strapping sequence that ensures force generation directly on the tibia, opposing anterior translation.

Aesthetics

With its streamlined look, low profile and vibrant colors, the LEGEND is a brace that your patients will ask for after just one glance. Designed with low profile in mind, it is also ideal to wear underneath clothing.

The Material

The LEGEND starts with a solid, one-piece aluminum core structure. The aluminum is then covered and sealed with a Kraton[®] elastomer. Integrated padding is recessed for optimal comfort and further reduces the profile of the brace while adding aesthetic appeal.

The LEGEND should be told. Order today.

To arrange a demonstration or to order the new Legend from DonJoy, simply contact your local sales distributor or call DonJoy direct at **1-800-336-6569** in the U.S. or (**619**) **438-9091**.

KRATON IS A REGISTERED TRADEMARK OF SHELL CHEMICAL COMPANY.

Smith & Nephew DonJoy Inc.

JOURNAL OF ATHLETIC TRAINING

Official Publication of

The National Athletic Trainers' Association

Volume 30, Number 2, June

Infective Endocarditis in a Collegiate Wrestler	
Jason P. Hodde, MS, ATC, Stephen F. Badylak, DVM, PhD, MD, Cecelia L. May, MD, Gerritt F. Smith, MD, FACS	105
Taping and Semirigid Bracing May Not Affect Ankle Functional Range of Motion	100
Tory R. Lindley, MA, ATC, ATR, and Thomas W. Kernozek, MS	109
Legislative Funding of Athletic Training Positions in Public Secondary Schools Barton P. Buxton, EdD, ATC, Eric M. Okasaki, MEd, ATC, Kwok W. Ho, PhD, Michael R. McCarthy, EdD, ATC, PT	115
The Elusive Slipped Capital Femoral Epiphysis Bruce C. Johnson, MEd, L/ATC, and Lori A. Klabunde, FNP, PA-C, BSN	124
Changes in Athletic Training Education as a Result of Changing From NATA-PEC to CAAHEP Audrey L. Mathies, MEd, ATC, Craig R. Denegar, PhD, ATC, PT, and Robert W. Arnhold, PhD	129
Management of Sports-Induced Skin Wounds	
Danny T. Foster, MA, ATC, Laura J. Rowedder, MS, ATC, and Steven K. Reese, MS, ATC	135
Wound Management: The Occlusive Dressing Scot B. Rheinecker, MS, ATC, PA-S	143
Arterial Supply to the Human Anterior Cruciate Ligament	
Brian J. Joy, ATC, Richard A. Yeasting, PhD, Dennis E. Morse, PhD, and Patricia McCann, MS.	149
Fracture Through the Distal Femoral Epiphysis	
Laura C. Decoster, ATC, CSCS, and James C. Vailas, MD	154
The Effects of Prophylactic Knee Bracing on Running Gait C.L. Liggett, MS, R.S. Tandy, PhD, and J.C. Young, PhD.	159
Thoracic Compression Factor in a Basketball Player Vicki L. McHugh-Pierzina, ATC, Debra A. Zillmer, MD, PT, and Charles E. Giangarra, MD	163
Interrater Reliability of Isokinetic Measures of Knee Flexion and Extension	
Douglas R. Keskula, PhD, PT, ATC, Jeffrey S. Dowling, MHE, PT, Virginia L. Davis, MEd, PT, ATC, Paula W. Finley, PT,	
and Daniel L. Dell'Omo, ATC	167
A Review of Selected Blood-Borne Pathogen Position Statements and Federal Regulations	
Brent L. Arnold, PhD, ATC	171
Taping the Hammer Toe	
Benjamin H. Reuter, MSEd, ATC, CSCS	178
An Electronic Daily Injury Report System	100
Richard Ray, EdD, ATC	100
EPARTMENTS	
Editorial	101
New Products	182
Request for Proposals	186
Call for Abstracts	188
CEU Quiz	190
Advertisers' Index	192

StairMaster SPORTS/MEDICAL PRODUCTS, INC.

Call 1.800.635.2936

The CardioSquat

is an excellent

adjunct to a physical

conditioning program

for cardiac patients

because it

simultaneously

improves aerobic

capacity and lower

body muscular

fitness.



Barry Franklin, Ph.D., FAACVPR Director, Cardiac Rehabilitation William Beaumont Hospital Royal Oak, MI

WHEN DOCTORS TALK HEART TO KNEE, THEY SEE EYE TO EYE.

By providing
 controlled, targeted
 stress to specific
 joint areas, the
 CardioSquat[™] is the
 safest and most
 effective exercise
 modality for
 individuals with

orthopaedic

problems.



Fred Allman, M.D., FAAOS Orthopaedic Surgeon Atlanta Sports Medicine Clinic Atlanta, GA

© 1995 StairMaster Sports/Medical Products, Inc. / StairMaster, StairMaster and Crossrobics are registered trademarks and CardioSquat and Crossrobics logo are trademarks of StairMaster Sports/Medical Products, Inc.

Professional Growth and Maturity

Kenneth L. Knight, Editor-in-Chief

You have received a bonus with this issue of the journal-our first-ever supplement. The supplement resulted from four factors: an increase in the quality and quantity of manuscripts submitted to the journal, an increase in the quality and quantity of abstracts submitted for review for presentation at the Free Communication Sessions of the NATA Annual Meeting, the desire and financial ability of the NATA Research and Education Foundation to support such an effort, and the desire of the NATA Board of Directors to provide more for NATA members.

ditorial

As the quality and quantity of original manuscripts increases, we must either find more space to publish them or become more selective and thus reject material that is of benefit to sports medicine clinicians and scientists. The space occupied by last year's annual meeting Free Communications abstracts is equal to five or six manuscripts, but the increase in accepted abstracts this year would have taken the place of three or four additional manuscripts. So, by publishing the abstracts in a supplement, we freed up space for eight to ten manuscripts that we would not have been able to publish otherwise—almost an entire issue.

Both events suggest increased growth and maturity of the athletic training profession. The body of athletic training scholars and scientists is expanding, and their efforts continue to expand the body of knowledge of athletic training. Thus, science is increasingly influencing the art we practice each afternoon and weekend in training rooms and on fields and courts of athletic competition. This will lead to an increased quality of health care.

Another indication of increased maturity and professionalism is the increase in the number of athletic training journals. *Athletic Training: Sports Health Care Perspectives* was launched in January by Mosby-Year Book Inc, in collaboration with the NATA. Mosby-Year Book publishes over 100 medical and allied health "yearbooks"; some as hard-covered single yearly volumes and others as soft-covered quarterlies, eg, *AT Perspectives*. No matter what the format, each yearbook is a compilation of abstracts of current literature in a specific profession and with a commentary concerning the abstracted article by professionals in the field. The editors of *AT Perspectives* review over 950 national and international medical and sports health care-related journals and select articles with information important to athletic trainers. *AT Perspectives* is more than just abstracts, though. As the name implies, each abstract is put into perspective with a commentary by one of the editors. The intent is to allow busy athletic trainers to keep up with the most important literature in the field without having to spend hours in a medical library combing through hundreds of journals. I also understand that Human Kinetics is launching a new athletic training journal next year.

All these additional educational helps are indications that the profession is maturing. Thanks to the scientists, scholars, and educators whose hard work is making these things available; but, more importantly, congratulations to the thousands of clinicians in the field who are using the new knowledge and insights of the scientists, scholars, and educators to provide greater quality of care. And kudos to our leaders for spending our money wisely, and to all who have contributed to the NATA Research and Education Foundation.



IN WITH RAGE.

JOHNSON & JOHNSON QUALITY ATHLETIC TAPES PROVIDE THE BEST DEFENSE AGAINST INJURY.



Injury prevention. It's the number one reason why the majority of certified athletic trainers, at all levels of competition, rely on JOHNSON & JOHNSON athletic tapes. The unbeatable fit of JOHNSON & JOHNSON provides critical support and protection against injury, giving athletes the confidence to perform at the top of their game...whatever game they play. Such superior design and performance also means consistent unwind, less waste and better value.

Don't leave your players open for injury. Send them in with the coverage of JOHNSON & JOHNSON.

Johnson & Johnson

©JOHNSON & JOHNSON Consumer Products, Inc., 1995

We have just the quality you need.





Model 345 - Professional Exercise Table





Model 73, 75 & 74 - Positioning Pillows



Model 605 - Shoulder Wheel



Model 227 – Rocker Balance Square



Model 3010 shown with 3015 ladder - Abdominal Exercise Board

The ultimate in quality equipment...



BAILEY MANUFACTURING COMPANY • 118 LEE STREET • LODI, OHIO 44254 Mail inquiries: P.O. Box 130, Lodi, Ohio 44254-0130 (216) 948-1080 • 800-321-8372 • FAX (216) 948-4439 Complete Equipment Catalog Available

Infective Endocarditis in a Collegiate Wrestler

Jason P. Hodde, MS, ATC; Stephen F. Badylak, DVM, PhD, MD; Cecilia L. May, MD; Gerritt F. Smith, MD, FACS

ABSTRACT: A 21-year-old collegiate wrestler was admitted to the hospital suffering from acute left lower quadrant abdominal pain. Blood cultures taken at the time of admission showed *Staphylococcus aureus*. The results of a computed tomography scan and a two-dimensional echocardiogram were consistent

The term bacterial infective endocarditis denotes infection of the endocardial surface of the heart due to the presence of a bacterial organism. It is classically associated with infection caused by *Staphylococcus aureus* and other staphylococcal and streptococcal species.^{4,10} Infective endocarditis is uncommon in healthy patients with normal heart valve structure and function.¹⁰ A review of the literature yields no reports of infective endocarditis specifically linked to athletic participation.

Considered universally fatal only 45 years ago, this disease still carries great health risks to the infected athlete. Therefore, it is important for the athletic trainer and physician to be aware of the potential of this life-threatening disease and to be ready to initiate appropriate diagnostic and treatment procedures.

CASE REPORT

A 21-year-old Division I collegiate wrestler presented with intermittent fevers and sudden onset of acute left lower quadrant pain that radiated to the groin. The athlete had gone to bed asymptomatic, but awakened several times throughout the night as pain became more frequent and severe. By morning, he was unable to rise from bed unassisted.

Upon admission to the hospital, he exhibited an elevated white blood cell count of $2.19 \times 10^7 \text{ L}^{-1}$ and a temperature of 40°C (104°F). Blood cultures drawn at the time of admission subsequently returned positive for *S aureus*. He was observed in the hospital overnight, throughout which time his pain became more intense. He exhibited distinct peritoneal signs. Although localization of the pain was not consistent with appendicitis, this diagnosis could not be ruled out with certainty. Meckel's diverticulitis was also considered.

A diagnostic laparoscopy was performed to determine the source of his abdominal discomfort. The only abnormal finding was the presence of a slight fluid accumulation in the pelvic cavity. Culture of this fluid subsequently proved negative. An

Cecilia L. May is a physician of internal medicine in Lafayette.

Gerritt F. Smith is a physician associated with the Lafayette Surgical Clinic, Inc. in Lafayette.

with a diagnosis of infective endocarditis. Therapy consisted of a 14-day hospitalization, a 28-day course of parenteral antibiotics, and subsequent follow-up visits. He returned to full participation in wrestling after 15 weeks.

abdominal and pelvic computed tomography scan showed low density splenic lesions consistent with multifocal abscesses. An echocardiogram was obtained to rule out infective endocarditis, and an internal medicine consultation was obtained.

The two-dimensional echocardiogram showed an irregular, vegetative lesion on the aortic valve, mild tricuspid insufficiency, and trivial mitral valve insufficiency. A repeat echocardiogram obtained 10 days after the first revealed nodular thickening of the noncoronary cusp of the aortic valve and of the anterior loop of the mitral valve. These findings were also interpreted as consistent with vegetative lesions.

Findings obtained from the initial echocardiogram, coupled with the *S aureus* bacteremia, led to the diagnosis of infective endocarditis. The patient was given intravenous antibiotics (2 g cefazolin sodium IVq8h (Kefzol; Lilly, Indianapolis, IN) and 200 mg gentamicin sulfate IVq8h (Garamycin; Schering, Kenilworth, NJ). Repeat blood cultures were obtained daily for the next 7 days.

The patient's fever subsided gradually over the initial week of hospitalization. After 7 days, his temperature returned to 37°C (98.6°F) and remained there for the rest of his hospital course. His left lower quadrant and left inguinal pain improved daily and he was given physical therapy for assistance with ambulation. He was treated with etodolac (Lodine 300 mg; Wyeth-Ayerst, Philadelphia, PA) and hydrocodone bitartate/ acetaminophen (Lortab 2.5 mg/500 mg; Witby, Richmond, VA) as needed for control of pain.

At the time of discharge, his white blood cell count was $9.7 \times 10^6 \text{ L}^{-1}$. He was mildly anemic, which is characteristic of chronic disease with hemoglobin of 11.7 g/dL. All other hematologic indices were within normal limits. Additional blood cultures obtained for follow-up showed no growth of *S aureus*. At the end of 14 days of hospitalization, we decided that he could continue the remainder of the 28-day course of antibiotics as an outpatient.

Even before the completion of the antibiotic treatment, the patient was allowed to begin light exercise and physical therapy under the direction of the team physicians and the athletic training staff at the university. He resumed limited activity with the wrestling team 8 weeks following the onset of symptoms and gradually returned to full participation after 15 weeks without complications.

Jason P. Hodde and Stephen F. Badylak are associated with the Division of Intercollegiate Athletics at Purdue University at Mackey Arena in West Lafayette, IN 47907.

Upon diagnosis, the athlete was asked about previous history of skin trauma, abuse of street drugs or steroids, or a history of sharing needles. He vehemently denied drug abuse, but indicated a history of wrestling with uncovered wounds because dressings would not stay in place.

A bacterial culture of the wrestling surface revealed *S aureus* in all of the samples tested. Testing to determine the strain of the microorganism was initiated, but samples of the patient's blood were discarded before evaluation. Unfortunately, the haste with which the patient's blood samples were discarded limited the ability to make the definitive link between the disease, the microorganism, and the wrestling surface.

DISCUSSION

Once the incident was reported, definitive diagnosis was critical to the favorable outcome of this athlete's condition. However, simple preventive measures could have prevented this incident from occurring.

Clinical Manifestations

The amount of time that passes between an event likely to cause bacteremia and the onset of infective endocarditis can be as short as 2 weeks.⁸ Fever rarely spikes above 39.8°C (103°F)¹¹ and routinely lasts for no longer than 9 days. Patients may also complain of abdominal pain secondary to emboli to the gastrointestinal tract, liver, spleen, and kidneys.⁵

The patient's history will often reveal fatigue, weakness, nausea and vomiting, headache, and severe muscle pain.¹⁰ He or she may have a history of an abnormal heart condition that results in turbulent blood flow across the heart's valvular surface. Rheumatic heart disease, congenital heart disease (especially patent ductus arteriosus, ventricular septal defect, and bicuspid aortic valve), Marfan's syndrome, and mitral valve prolapse may all cause the turbulence that allows bacteria to attach and proliferate,^{4,6,9} although nearly one third of the cases attributed to *S aureus* occur in individuals with no clinically detectable cardiac disease.^{1,10} In acute infective endocarditis, the most common infective agent is the *S aureus* bacterium, an agent causing death in nearly 40% of all reported cases.⁶

Pathologic Changes

Bacterial infection of the heart may lead to destruction of the underlying valve, perforation of the valve leaflet, and rupture of the chordae tendinae, intraventricular septum, or papillary muscle. The associated bacteremia may cause pathologic changes in other organs. Kidney abscesses, infarction, and glomerulonephritis have all been reported.⁴ Splenic abscess formation, although uncommon, has been reported,^{5,10} as have splenic enlargement and infarction.¹¹

Treatment

The blood culture is the single most important laboratory test performed to diagnose infective endocarditis.⁵ A two-

dimensional echocardiogram may be performed to evaluate the heart and associated valve structures. The use of echocardiography in the diagnosis of infective endocarditis was first reported in 1973, and has accurately identified lesions on all valves.¹⁰ A positive echocardiogram should serve as adjunctive evidence to clinical manifestation in order to warrant aggressive treatment with antibiotics and surgical intervention.^{3,7}

Although the infective organism may be extremely sensitive to the antibiotics used, complete eradication takes several weeks.⁶ Relapse is not uncommon. Parenteral antibiotics are recommended over oral drugs because of the importance of sustained antibacterial activity.⁶ To fully eradicate the etiologic agent and reduce the risk of relapse, extended drug administration for 4 to 6 weeks is necessary.

The choice of antibiotic depends on the etiologic agent and should produce a rapid bactericidal effect. In infective endocarditis where *S aureus* is the etiologic agent, synergistic combinations of antibiotics such as a penicillin (nafcillin, methicillin, or oxacillin, 1.5 to 2 g IVq4h) or a cephalosporin (cefazolin, 2 g IVq8h, or cephalothin, 2 g IVq4h) and gentamicin (1.0 to 1.7 mg/kg IVq8h), are often used.

RECOMMENDATIONS

A review of the sports literature on illness in athletics yields no information to suggest that athletes participating in wrestling are at greater risk for infective endocarditis than are other healthy athletes. However, because wrestlers tend to participate on porous mats in humid rooms with inadequate ventilation, bacterial colonization is facilitated. Any microorganism easily transferred via body fluids or direct body contact can infect multiple team members in the course of a single practice session and can cause significant health complications. For example, the transmission of herpes simplex virus type 1, herpes gladiatorum, has been a recognized health risk for wrestlers since the mid-1960s.²

In this case report, the athlete had a history of open skin wounds which he managed poorly during practice sessions. Although cause and effect cannot be demonstrated with certainty in this case, the findings strongly suggest a causal relationship between the wrestling activity, the wrestling surface, and the unusual occurrence of infective endocarditis in an otherwise healthy 21-year-old athlete.

This case demonstrates the need for proper hygiene and thorough daily scrubbing of practice surfaces to prevent bacterial colonization, as well as the necessity of proper care of skin wounds. It also stresses the need for immediate, accurate diagnosis, care, and treatment of acute diseases in which etiology is difficult to determine.

To reduce the risk of bacterial infection, the athletic trainer and team physician must work with the coach and the team to inhibit the colonization and spread of bacteria through the practice room. Such an effort requires implementation of daily mat cleaning with a bactericidal agent and installation of an adequate ventilation system in the practice area. Athletes should be encouraged to shower with an antibacterial soap before and after practice, and all members of the team harboring bacterial or viral infections should be removed from practice until they are deemed noncontagious. Furthermore, athletes with skin abrasions, lacerations, or eczema should be taught proper wound cleansing techniques, be required to practice with the wounds covered with a sterile dressing, and be withheld from participation if the integrity of the skin is seriously compromised.

REFERENCES

- Bayliss R, Clarke C, Oakley CM, Somerville W, Whitfield AGW, Young SEJ. The microbiology and pathogenesis of infective endocarditis. *Br Heart J*. 1983;50:513–519.
- Belongia EA, Goodman JL, Holland EJ. An outbreak of herpes gladiatorum at a high-school wrestling camp. N Engl J Med. 1991;325:906–910.
- Buda AJ, Zotz RJ, LeMire MS, Bach DS. Prognostic significance of vegetations detected by two-dimensional echocardiography in infective endocarditis. *Am Heart J.* 1986;112:1291–1296.
- Durack DT. Infective and noninfective endocarditis. In: Hurst JW, Schlant RC, Rackley CE, Sonnenblick EH, Wenger NK, eds. *The Heart: Arteries* and Veins. 7th ed. New York, NY: McGraw-Hill Inc; 1990:1230–1255.
- Freedman LR. Infective Endocarditis and Other Intravascular Infections. New York, NY: Plenum Medical Book Co; 1982:137–206.
- Kaye D. Changing pattern of infective endocarditis. Am J Med. 1985; 78(suppl 6B):157–162.
- Latham RH. Medical therapy versus early surgical intervention in patients with endocarditis and vegetations seen on echocardiography. *South Med J*. 1991;84:1347–1351.
- Lederman MM, Sprague L, Wallis RS, Ellner JJ. Duration of fever during treatment of infective endocarditis. *Medicine*. 1992;71:52–57.
- McKinsey DS, Ratts TE, Bisno AL. Underlying cardiac lesions in adults with infective endocarditis. Am J Med. 1987;82:681–688.
- Scheld MW, Sande MA. Endocarditis and intravascular infections. In: Mandell GL, Douglas RG, Bennett JE, eds. *Principles and Practice of Infectious Diseases*. 3rd ed. New York, NY: Churchill Livingstone Inc; 1990:670–705.
- Weinstein L, Schlesinger JJ. Pathoanatomic, pathophysiologic, and clinical correlations in endocarditis (part I). N Engl J Med. 1974;291:832–837.



IF THE SHOE FITS WEAR IT !

A common problem — fitting a typically bulky ankle brace into a shoe. Too often, it requires moving up a full shoe size. Not so with the ASO[®].

The Medical Specialties' ASO (Ankle Stabilizing Orthosis) is made of thin, durable ballistic nylon. It fits easily into an athletic or street shoe.

Superior support is achieved through exclusive non-stretch nylon stabilizing straps that mirror the stirrup technique of an athletic taping application. The calcaneus is captured, effectively locking the heel.

Join the growing number of physicians and athletic trainers who have discovered the *support*, the *economy*, and the *fit* of the ASO.

For more about the ASO and the distributor near you, call Medical Specialties toll-free, 1-800-334-4143.



ASO® is a registered trademark of Medical Specialties, Inc., 4600 Lebanon Road, Charlotte, NC 28227. ©1992, U.S. Patent #5,067,486

It's All There In Black And White

Whether you choose Swede-O's Classic White or new Black "ANKLE LOK TM" brace, you get all the patented support features and all the comfort that makes Swede-O rated #1 with athletes. The inset photo is a special brace with a clear side panel that allows you to see how the Swede-O "ANKLE LOK" works better in two ways.

The offset eyelets give you greater leverage so you can lace a Swede-O tighter for a more effective "ANKLE LOK"

ENEDE-O-INTVERSAL



The offset side panel traps the tightened lace between the inner and outer flap so Swede-O holds the laces tighter longer than any other brace

The best braces have the tighest laces and now you can see Swede-O laces start tighter and stay tighter longer so the exclusive patented Swede-O "ANKLE LOK" provides better support in black and white.

Call toll free today for information: 800-525-9339



In Minnesota call: 612-674-8301 or ask your authorized Swede-O dealer

Taping and Semirigid Bracing May Not Affect Ankle Functional Range of Motion

Tory R. Lindley, MA, ATC, ATR; Thomas W. Kernozek, MS

ABSTRACT: The comparative effects of adhesive tape and three semirigid ankle orthoses on ankle functional range of motion were studied on 11 college football athletes. Maximum plantar flexion and maximum dorsiflexion were measured under five conditions to determine functional range of motion. Testing conditions included: control (no supportive device), adhesive tape with moleskin, the Airstirrup "Training" orthosis, the Active Ankle "Trainer" orthosis, and the Ankle Ligament Protector. A 200-Hz video camera was used to record subjects' motions in the sagittal plane while they ran a series of 40-yd

sprints. Videotape was analyzed with the Peak Performance Technology Motion Measurement System. Data were analyzed with a Repeated Measures MANOVA. Differences were found among treatments for maximum plantar flexion and functional range of motion. Follow-up analyses indicated that the Ankle Ligament Protector was the only supportive device that was significantly more restrictive than the control. The Airstirrup, Active Ankle, and adhesive tape with moleskin do not significantly affect functional range of motion during running.

Frecognized the need for injury prevention and the minimization of time lost from competition resulting from ankle injury.¹⁰ When an athlete is injured, an athletic trainer seeks a supportive device to help prevent reinjury while allowing the athlete to maintain some degree of function in his/her sport. In the past, this has been attempted through modification of standard taping techniques such as the basketweave.¹⁷ Recently, athletic trainers have begun to use manufactured ankle stabilizers. The design and choice of lace-on braces and semirigid orthoses over adhesive tape has generated a debate over the effectiveness of taping or bracing in the prevention of ankle injury and reinjury.

Adhesive tape is an effective method of external support for the prevention of ankle sprains.^{1–5,8,9,13,17,18,20,22} However, ankle taping has been shown to adversely affect running and agility test performance of noninjured athletes.^{11,12,19} It has also been found that adhesive tape failed to maintain a consistent amount of support throughout extended periods of activity.^{3,5,17,18} This controversy over the effectiveness of taping on motor performance and injury prevention has led to the analysis of various ankle stabilizers and semirigid orthoses as viable means of support.^{4–7,20}

Although some authors have examined how adhesive taping affects motor performance, the majority of the research conducted on ankle orthoses has used open kinetic chain testing. Thus, the question of how orthoses affect functional range of motion has been largely ignored. How do these restrictive devices affect the athlete's ability to produce similar movements demonstrated without support? If an athlete's functional range of motion is impaired significantly, then his/her motor performance may suffer. The purpose of this study was to investigate how adhesive tape and semirigid orthoses affected functional range of motion.

METHODS

Eleven male athletes (age = 21.1 ± 1.7 yr, ht = 186.9 ± 7.62 cm, wt = 91.5 ± 12.8 kg) from the University of Minnesota at Minneapolis volunteered as subjects. All subjects were Division I football players with experience in wearing prophylactic adhesive tape during practices and games.

All subjects reported no recent history of significant ankle sprains. The team orthopedic physician confirmed this information with a physical examination including ligamentous and range-of-motion tests 1 week before testing. All passive range-of-motion assessments made by the physician were within normal limits (20° to 25° eversion, 40° to 45° inversion, 30° to 50° plantar flexion, and 20° to 30° dorsiflexion.) All subjects gave written consent to participate under the guide-lines prescribed by the Committee on the Use of Human Subjects in Research at the University of Minnesota.

Our experimental design included four dependent variables (functional range of motion, maximum ankle plantar flexion, maximum dorsiflexion, and time in the stance phase) and one independent variable (type of ankle supportive device) with five levels of treatment. Each subject received five treatments:

- 1. Control (no ankle supportive device);
- 2. Active Ankle "Trainer" Orthosis (Active Ankle Systems, Louisville, KY);
- Airstirrup Ankle "Training" Orthosis (Aircast Inc, Summit, NJ);
- 4. Ankle Ligament Protector (ALP) (Donjoy Orthopedics, Carlsbad, CA); and
- 5. Closed basketweave with moleskin stirrup technique.

The order in which the subjects were assigned the treatment was counterbalanced through the use of a Latin Square design. All orthoses were fitted according to manufacturers' specifications.

Adhesive taping consisted of a basketweave with moleskin stirrup technique. Supplies included 1-inch Zonas adhesive tape and foam prewrap (Johnson and Johnson Products Inc, New Brunswick, NJ), spray adherent, heel and lace pads, and a 3-inch moleskin stirrup. After spray adherent, prewrap, and

Tory R. Lindley is Head Athletic Trainer at Hamline University in St. Paul, MN 55104.

Thomas W. Kernozek is a researcher in the Division of Kinesiology at the University of Minnesota Biomechanics Laboratory.

heel and lace pads were in place, the closed basketweave consisting of three stirrups, three horseshoes, two medial heel locks, and two lateral heel locks was applied over the prewrap. A moleskin stirrup was applied before the heel locks. The same certified athletic trainer applied all treatments. During testing, the subjects wore T-shirts, athletic shorts, the same brand of athletic socks, and the same brand/model of shoe (Nike BBX Low-top, Beaverton, OR).

We videotaped subjects while they ran a series of 40-yd (36.6 m) forward sprints on a level artificial turf surface. They performed five successful trials for each experimental condition. Criteria for a successful trial included: 1) proper fit of each supportive device, 2) running speed 85% (\pm 3%) of the subjects' best sprint time confirmed by photocells, and 3) right foot landing within the camera's field of view.

We measured running speed using infrared photocells interfaced with a digital clock. The infrared photocells were placed 15.5 m and 20.5 m from the start line. The best performance time for the 40-yd sprint was measured once, 5 days before testing. We calculated the time for the fastest speed over 5 m (5.468 yd). We calculated 85% of the best time over 5 m to create the time parameters required for each videotaped trial.

Instrumentation

Trials were videotaped and analyzed with the Motion Measurement System (Peak Performance Technologies Inc, Inglewood, CA). We recorded each trial on Fuji professional VHS video tapes with a 200-Hz video camera with a 70-mm zoom lens (Nac Inc, San Francisco, CA). The shutter speed was 1/1000 during testing. Using the Peak 2D Manual Acquisition System (version 5.0.7), we analyzed each videotaped trial. A colored cursor superimposed over the video image was used to identify x/y coordinates of the anatomical landmarks. We controlled the cursor's position manually with a hand-held mouse.16 Reliability of this system was tested by computing a standard deviation of the calculated position of 16 fixed markers.²¹ The mean of these 16 standard deviations was then calculated to be \pm .99 mm for the x-coordinates, and \pm 1.13 mm for the y-coordinates.²¹ As an additional reliability test of the manual acquisition system, the principal investigator measured twice the maximum angle of ankle dorsiflexion for 20 randomly chosen trials. A Pearson correlation coefficient of .919 indicated strong reliability between repeated trials.

Testing Protocol

We performed all testing indoors on level artificial turf. We videotaped one stance phase (right foot only) during running for each trial as the subject ran in a path perpendicular to the camera. Before the application of the first treatment condition, subjects performed a specific warm-up procedure that included 3 minutes of jogging and 2 minutes of lower extremity static stretching. Following this warm-up, we applied surface markers. We measured ankle range of motion by placing white markers 1 inch (2.54 cm) in diameter, on the right lateral joint line of the knee, the lateral malleolus, the lateral aspect of the calcaneus, and the base of the fifth metatarsal. We affixed knee

markers to the skin with a spray adherent while applying foot markers directly to the exterior surface of the shoe. We placed ankle markers on the skin or support device over the lateral malleolus.

We calculated ankle range of motion as the angle between the line segment formed by the knee and ankle markers and the line segment formed by the two foot markers. The Figure indicates both marker placement and the procedure for the angle calculations. We defined neutral position of the ankle as a 90° angle between the lower leg and the foot. Dorsiflexion angles equaled values less than 90° and plantar flexion angles equaled values greater than 90°. We calculated functional range of motion from a maximum plantar flexion value minus a maximum dorsiflexion value for each trial.

We applied the first experimental condition to the right ankle and the subject ran 40-yd sprints until five successful trials were completed. After the subject ran with the first supportive device, there was a 3- to 5-minute interval for removal and application of the next treatment. Once the subject was fitted with a supportive device, we allowed him up to 2 minutes to become comfortable with the device. Total time to complete the running trials for all experimental conditions was between 30 and 40 minutes. We tested all subjects on the same day.



Markers (1 in, 2.54 cm) were placed on the lateral aspect of the knee in line with the joint line, the lateral malleolus, the lateral aspect of the calcaneus, and the base of the fifth metatarsal. Ankle range of motion was calculated as the angle formed by the line segment of the two lower leg markers (knee and malleolus) and the line segment formed by the two foot markers (calcaneus and fifth metatarsal).

Data Analysis

Each frame of the stance phase of the running cycle was manually digitized. Digitizing started six frames before heelstrike and six frames after toe-off to minimize the effects of digital filtering of the raw position data.¹⁶ We used a Fourth Order Butterworth recursive digital filtering technique to smooth the raw position data. We chose a cutoff frequency of 6 Hz after visual inspection of the position data's response to various cutoff frequencies.²³

We calculated angles from the four markers described previously. From the five trials for each supportive device and the control, we calculated mean values for: 1) maximum plantar flexion, 2) maximum dorsiflexion, 3) functional range of motion, and 4) time in the stance phase. Using these values, we calculated an overall mean across all subjects for each of the four categories listed above. The outcome measure was mean values for maximum plantar flexion, maximum dorsiflexion, and functional range of motion for each of the five support conditions across all subjects.

The data were analyzed with a repeated measures multivariate analysis of variance (MANOVA) and the Fischer LSD post hoc analysis was used to evaluate differences among conditions.

RESULTS

Mean range-of-motion values and standard deviations for all conditions are contained in the Table. For all subjects, maximum plantar flexion occurred at the end of the stance phase, as the toe left the floor. Maximum dorsiflexion occurred at different times and varied from subject to subject. Maximum dorsiflexion occurred either at heel strike or just before heel-off.

There were differences in maximum plantar flexion between groups when all four dependent variables were combined (Wilks' lambda = .71, approximate F(4,50) = 2.42, p < .05). Maximum plantar flexion for the ALP orthosis (97.8°) was significantly less than for the other four conditions (103.5° to 105.2°; p < .05). Maximum plantar flexion was 7% less than control when subjects were wearing the ALP orthosis.

No supportive devices differed significantly in maximum dorsiflexion (p < .05). There were differences in ankle functional range of motion when the four dependent variables were combined (Wilks' lambda = .71, approximate F(4,50) = 3.00, p = .027). Functional range of motion for the ALP orthosis (25°) was significantly less than for the other four

Mean Range of Motion Scores (Degrees) ± Standard Deviations for Maximum Dorsiflexion, Maximum Plantar Flexion, and Functional Range of Motion

Type of Support Device	Maximum Plantar Flexion	Maximum Dorsiflexion	Functional Range of Motion
Control	105.1 ± 6.7°	74.7 ± 5.4°	30.3 ± 3.8°
Adhesive Tape	$103.5 \pm 7.6^{\circ}$	$74.7 \pm 4.8^{\circ}$	$28.8 \pm 4.4^{\circ}$
Airstirrup	$103.9 \pm 6.7^{\circ}$	$75.3 \pm 4.4^{\circ}$	28.6 ± 4.1°
Active Ankle	$105.2 \pm 6.0^{\circ}$	$75.9 \pm 4.1^{\circ}$	$29.3 \pm 3.4^{\circ}$
ALP	$97.8\pm5.2^{\circ}$	$72.8\pm3.5^\circ$	$25.0\pm3.7^\circ$

conditions (28.6° to 30.3°; p < .05). Functional range of motion when subjects were wearing the ALP orthosis was 17% less than control and 13% less than tape with moleskin, the Airstirrup, and the Active Ankle orthoses.

Mean velocity for all subjects, over all trials was 6.4 ± 0.78 m/sec. In addition, no significant differences occurred in stance time between subjects and experimental conditions. This indicated that speed was consistent across each subject and condition.

DISCUSSION

We did not address the effectiveness of any support devices to prevent inversion or eversion injuries in this study, but merely their effects on functional range of motion during motor performance. Only one orthosis, the ALP, significantly restricted the ability to achieve maximum plantar flexion and functional range of motion as compared to the unsupported condition. The other three supportive devices allowed similar range of motion in plantar flexion and dorsiflexion as when subjects wore no supportive device.

The design of the support device dictates the motions that are to be restricted.⁴ According to this hypothesis, tape on the anterior and posterior aspects of the ankle would be expected to restrain maximum plantar flexion and maximum dorsiflexion. Although this may occur during open kinetic chain testing of ankles,^{1–3} it apparently does not occur when testing in the closed kinetic chain.

Maximum plantar flexion values and maximum dorsiflexion values for the Airstirrup and Active Ankle concurred with the findings of Gehlsen et al.⁴ The open anterior and posterior design of these devices did not restrict these ranges of motion in closed kinetic chain testing.

There is a lack of research related to plantar flexion range of motion for the ALP orthosis. The results of this study indicated that a 7% reduction in maximum plantar flexion was associated with a 17% restriction of functional range of motion. Maximum dorsiflexion values were not significantly affected by wearing the ALP. Under these testing conditions, the posterior semirigid, splint design of the orthosis limited subjects' ability to maximally plantar flex the ankle during the stance phase of running.

Research on open kinetic chain testing has demonstrated that normal ankle range of motion was impaired by supportive devices. Several researchers¹⁻⁴ have demonstrated reduced plantar flexion and dorsiflexion using active, open kinetic chain testing procedures. Testing at 180°/sec on the Cybex 340 dynamometer, Gehlsen et al⁵ reported 63.5° and 61.7° maximum range of motion (plantar and dorsiflexion combined) for the Active Ankle and Airstirrup, respectively. These values greatly contrasted the 29.3° for Active Ankle and 28.6° provided by the Airstirrup in closed kinetic chain testing used in this study.

Obviously, range-of-motion demands are not as great during the running stance phase when the ankle is functioning in the closed kinetic chain as they are in the open kinetic chain. Millron and Cavanagh¹⁴ reported 48.2° of ankle functional range of motion, as measured by an electrogoniometer, while subjects ran at 3.4 m/sec on a level treadmill. In this study, video analysis showed 30.2° of mean ankle functional range of motion at a greater average velocity of 6.4 m/sec.

Because range-of-motion demands are not as great during the running stance phase, the range restrictive characteristics of these supportive devices are not reached during running. Our results may support this contention by showing that some supportive devices may be worn without compromising the normal ranges of motion during running. Thus, open kinetic chain testing of functional range of motion may not be applicable to the manner in which the supportive devices respond to sport-specific activity. Closed kinetic chain testing, in contrast, may replicate more closely the movement characteristics of the lower leg that occur on the athletic field.

Previous studies performed in the closed kinetic chain measured ankle plantar flexion and dorsiflexion when subjects wore adhesive tape. McCorkle¹² used an electrogoniometer to show that functional range of motion was restricted by 6.4% by adhesive tape when compared to the control group during a treadmill running test. McIntyre et al¹³ found that adhesive tape limited plantar flexion as measured by film analysis during walking.

Other closed kinetic chain studies have investigated motor performance scores. Findings by Mayhew¹¹ indicated that adhesive tape affected performance during activity, such as the long jump and the vertical jump. Both of these activities depend largely on plantar flexion of the ankle for propulsion. Running times, on the other hand, were not significantly reduced when subjects wore adhesive tape.¹⁵ Our results are similar to those of Paris¹⁵ who reported that normal running patterns were not significantly affected by the application of adhesive tape with moleskin, the Airstirrup, or the Active Ankle.

The results of this study showed that adhesive tape with moleskin, the Airstirrup Ankle "Training" orthosis, and the Active Ankle "Trainer" orthosis were equally effective in providing functional range of motion comparable to the control condition. The ALP orthosis was the only supportive device that significantly decreased functional range of motion. These results support the athletic trainer's use of adhesive tape with moleskin, the Airstirrup orthosis, and the Active Ankle orthosis as viable support devices that do not compromise plantar flexion or dorsiflexion during running.

ACKNOWLEDGMENTS

We would like to thank Garrick Z. Larson, ATC, and Scott Gardner, ATC, for their assistance during data collection. We would also like to extend appreciation to Mary Jo Kane, PhD; Lela June Stoner, PhD; Nancy Greer, PhD; and Liza Arendt, MD for their guidance in this investigation.

REFERENCES

- Abdenour TE, Saville WA, White RC, Abdenour MA. The effect of ankle taping upon torque and range of motion. *Athl Train, JNATA*. 1979;4:227– 228.
- Fisher RD. The measured effect of taping, joint range of motion, and their interaction, upon the production of isometric angle torques. *Athl Train*, JNATA. 1982;3:218–223.
- Fumich RM, Ellison AE, Guerin GJ, Grace PD. The measured effect of taping on combined foot and ankle motion before and after exercise. Am J Sports Med. 1981;9:165–169.
- Gehlsen GM, Pearson D, Bahamonde R. Ankle joint strength, total work, and ROM: comparison between prophylactic devices. *Athl Train, JNATA*. 1991;1:62–65.
- Greene TA, Hillman SK. Comparison of support provided by a semirigid orthosis and adhesive ankle taping before, during, and after exercise. *Am J Sports Med.* 1990;18:498–506.
- Greene TA, Wight CR. A comparative support evaluation of three ankle orthoses before, during, and after exercise. J Orthop Sports Phys Ther. 1990;11:453–466.
- Gross MT, Bradshaw MK, Ventry LC, Weller KH. Comparison of support provided by ankle taping and semirigid orthosis. J Orthop Sports Phys Ther. 1987;9:33–39.
- Kimura IF, Nawoczenski DA, Epler M, Owen MG. Effect of the Airstirrup in controlling ankle inversion stress. J Orthop Sports Phys Ther. 1987;9: 190–193.
- Laughman RK, Carr TA, Chao EY, Youdas JW, Sim FH. Threedimensional kinematics of the taped ankle before and after exercise. *Am J Sports Med.* 1980;8:425–431.
- Libera D. Ankle taping, wrapping and injury prevention. Athl Train, JNATA. 1972;7:73–75.
- Mayhew JL. Effects of ankle taping on motor performance. Athl Train, JNATA. 1972;7:10–11.
- 12. McCorkle RB. A Study of the Effect of Adhesive Strapping Techniques on Ankle Action. Springfield, MA: Springfield College; 1963. Thesis.
- McIntyre DR, Smith MA, Denniston NL. The effectiveness of strapping techniques during prolonged dynamic exercises. *Athl Train, JNATA*. 1983;1:52–55.
- Millron MJ, Cavanagh PR. Sagittal plane kinematics of the lower extremity during distance running. In: Cavanagh PR, ed. *Biomechanics of Distance Running*. Champaign, IL: Human Kinetic Books; 1990:65–105.
- Paris DL. The effects of the Swede-O, New Cross, and McDavid ankle braces and adhesive ankle taping on speed, balance, agility, and vertical jump. J Athl Train. 1992;3:253–256.
- Peak Performance Technologies Inc. Users Reference Manual. Manual version 4230 for software 423;1991:H-2.
- Plummer PE. A Comparison of Athletic Taping Techniques with Respect to Ankle Inversion. East Lansing, MI: Michigan State University; 1991. Thesis.
- Rarick GL, Bigley G, Krast R. The measurable support of the ankle joint by conventional methods of taping. *J Bone Joint Surg [Am]*. 1962;44: 1183–1190.
- Robinson JR, Frederick EC, Cooper LB. Systematic ankle stabilization and the effect on performance. *Med Sci Sports Exerc.* 1986;18:625–628.
- Rovere GD, Clarke TJ, Yates CS, Burley K. Retrospective comparison of taping and ankle stabilizers in preventing ankle injuries. *Am J Sports Med.* 1988;16:228–233.
- Scheirman G, Cheetham PJ. Motion measurement using the Peak Performance Technologies System. *Presented at the World Congress of Biomechanics*; September, 1990; Los Angeles, CA.
- Seitz CJ, Goldfuss AJ. The effect of taping and exercise on passive foot inversion and ankle plantar flexion. *Athl Train, JNATA*. 1984;3:178–182.
- Winter DA, Sidwall HG, Hobson DA. Measurement and reduction of noise in kinematics of locomotion. J Biomech. 1974;7:157–159.



You've Helped Make Them The Best They Can Be. But Are You Giving Them The Best They Can Get?

You are if you're giving your team the Gatorade® Performance Series. Top teams rely on the Gatorade name because nothing works better to get a team prepared and help them achieve their best performances. Gatorade® Thirst Quencher is the ultimate performance fuel. It supplies energy and replaces lost fluids, speeding carbohydrates and electrolytes to the body for peak performance and fast rehydration. it helps reduce recovery time by rapidly restoring muscle glycogen. GatorPro[®] is a nutritional supplement packed with protein, carbohydrates, vitamins and minerals.

The newest members of the Gatorade Performance Series are GatorBar[™] and ReLode[®]. You get the balanced energy of real fruits and grains from GatorBar, while ReLode is a concentrated carbohydrate

GatorLode[®] is an easy way to carboload for sustained performance, helping your team go longer throughout their training. With its concentrated carbohydrate source



ator

Gatoradt

supplement in gel form.

Don't settle for second best. Find out how the Gatorade Performance Series can help your team be the best they can be. Call 1-800-634-5086.

THE SCIENCE OF GATORADE IS THE SCIENCE OF PERFORMANCE.

The Boston Knee Brace[™]



• The Boston Knee Brace is uniquely designed to track with normal tibial rotation during flexion of the knee and to encourage posterior tibial translation on the femur during flexion.

• The Boston Knee Brace can be ordered in three standard colors: black, red, and blue.

• Plaster impressions are requested with the patient's knee set in 5° of flexion. • The knee joints on the lower half of the Boston Knee Brace work independently of each other allowing for more normal knee motion.

• The joints are machined from aircraft aluminum alloy, while the thigh and calf cuffs are aluminum reinforced acrylic with a glass lay-up.

• The Boston Knee Brace is shipped with extension stops in 0°, 5°, 10°, and 15° increments.



Legislative Funding of Athletic Training Positions in Public Secondary Schools

Barton P. Buxton, EdD, ATC; Eric M. Okasaki, MEd, ATC; Kwok W. Ho, PhD; Michael R. McCarthy, EdD, ATC, PT

ABSTRACT: In 1991, approximately 21 000 student athletes were actively participating in organized athletics in Hawaii's 61 (38 public and 23 private) secondary schools. Of the 61 schools, only 5 (all private) employed full-time, NATABOC-certified athletic trainers (ATCs) to facilitate the sports health care of their respective student athletes. In an attempt to convince the state legislature that providing funding to hire ATCs was a primary health and safety issue in the state, a community-based educational platform was established and a twofold needs-assessment study was implemented statewide. The educational platform was aimed at parents, coaches, athletic directors, and school administrators. The needs-

-n attempting to facilitate health care reform in Hawaii and to convince the state legislature that providing appropriate sports health care was a major educational health and safety issue, a plan was developed to educate athletes, coaches, parents, athletic directors, school administrators, and state legislators on the importance of appropriate health care for secondary school students participating in high-risk activities (organized interscholastic sports). To support our belief that the need existed to hire allied health care professionals (NATABOC-certified athletic trainers or ATCs) to address the prevention, treatment, and rehabilitation of the estimated 21 000 students participating in the state's high school interscholastic athletic programs, two needs-assessment studies were developed. The first surveyed the state's 61 (38 public and 23 private) secondary schools regarding the current sports health care practices (statewide) and the second assessed injury rates for public school student athletes.

The purpose of this article is to detail the process undertaken by the state of Hawaii to generate change in the status of sports health care on a state level and to convince the legislature to fund that change. We also demonstrate the effectiveness of purposeful, qualitative, and descriptive needs-assessment studies to gather pertinent information for legislative and public

Eric M. Okasaki is Head Athletic Trainer for Men and a clinical instructor in the Athletic Training Education Program at the University of Hawaii at Manoa.

Kwok W. Ho is an associate professor and Chairman of the Department of Health, Physical Education and Recreation in the College of Education at the University of Hawaii at Manoa.

Michael R. McCarthy is associated with McCarthy Orthopedic Rehabilitation and Sports Medicine at Kailua, HI.

assessment studies consisted of a 30-question survey on the current practices of sports health care and a year-long injury surveillance survey within the 38 public secondary schools. There were significant differences between the public and private schools with respect to the practice of sports health care. The public school student athletes demonstrated a normative incidence of injury rate. These findings definitively quantified and qualified the need to hire ATCs in the public secondary schools. In July of 1993, the State of Hawaii funded a 2-year athletic training pilot program for approximately \$1.2 million, following an extensive lobbying effort and media campaign.

presentation. Finally, we present the findings of our surveys and how they enabled the state legislature and the Department of Education in the state of Hawaii to convince the governor to fund a 2-year athletic training pilot program for \$1 167 750 (15 salaries, fringe benefits, and supplies) in a mandated, zerogrowth state budget.

METHODS

We thought that the most productive way to influence change in the standard of sports health care was to initiate an education program for the consumers of sports health care. Therefore, a series of coaching education classes/workshops was proposed and subsequently funded by the state's Department of Education. These classes/workshops, in addition to a parent and coaching education series by the Hawaii Youth Sports and Fitness Program (previously funded by the state legislature), presented a succession of educational courses in sports medicine and the inherent risks of participation in organized athletics. Concomitantly, these lectures developed an educational platform on the importance of risk management in sports. The role delineation of the certified athletic trainer was presented, along with detailed information of sports liability, injury prevention, recognition of athletic-related injuries and illnesses, acute and long-term care of athletic-related injuries and illnesses, and the principles of athletic injury rehabilitation. The lecture series was presented by certified athletic trainers, physical therapists, exercise physiologists, and attorneys. All classes/workshops were presented free of charge and, upon completion, the participants received continuing education units and/or a certificate of completion. During these presentations to parents, coaches, athletic directors, and school administrators, the focus was always maintained on the accepted standard of care for student athletes in terms of supervision, equipment, warning of risk, provision of a safe

Barton P. Buxton is an assistant professor in the Department of Health, Physical Education and Recreation and the Athletic Training Education Program Director at the University of Hawaii at Manoa. He is also an associate professor at the John A. Burns School of Medicine Department of Family Practice and Community Health University of Hawaii at Manoa in Honolulu, HI 96822.

environment, proper instruction, appropriate matching of competitors, proper record keeping, adequate evaluation of injury and/or incapacity, and overall risk management.

After the educational platform was developed, we modified a questionnaire used in a previous sports health care study¹⁶ into a 30-question survey. The questions were designed to gather information concerning numbers of participants, practices of sports health care, qualifications of health care providers, and emergency policies and procedures currently being provided for the estimated 21 000 student athletes actively participating in organized high school athletic programs within the state (Table 1). We mailed surveys to the athletic directors throughout the state. The names and addresses (along with approval for the study) were obtained from the Hawaii High School Athletic Association. A cover letter explaining the purpose of the project and request for participation was attached. Each athletic director was asked to complete the survey and return it in an enclosed self-addressed, stamped envelope. After 6 weeks, we followed up with a mailing in an attempt to increase the response rate. After 3 weeks, we phoned nonresponding schools and gathered information through a phone interview.

Means $(\pm$ SD) and percentages of the responses were calculated from the collected data. We compared responses

between the public and private schools with a chi-square ("goodness-of-fit test") contingency table analysis. The difference between observed and expected frequencies were considered significant if the chi-squared value was equal to or less than the .05 level of probability.

In addition, we developed a 10-question injury surveillance form and distributed it to the athletic directors of all public high schools within the state. The form assessed gender, age, level (varsity or junior varsity), sport, injury location (body part), injury side (left or right), injury status (old or new), injury occurrence (practice or game), days of participation missed, and the initial treatment of the injured student athlete. The athletic directors made copies of the forms and distributed them to their coaching staffs. The coaches did all injury reporting. When an athlete reported an injury to a coach or missed more than 1 day of practice, the coach recorded the injury on a form. When a form was completed (athlete returned to practice or was out for the season), it was returned for analysis. A research assistant entered all data into a database and the means $(\pm SD)$ and percentages of the responses were calculated by gender, age, sport, injury location, injury status, occurrence, estimated days missed, and how the injuries were treated. For purposes of media presentation and legislative testimony, we also classified the injuries by severity, in

Table	1. Athletic	Directors '	Responses to Specific	Questions on	Practices of	Sports Health Care
-------	-------------	--------------------	------------------------------	--------------	--------------	---------------------------

Question			Response	Same all a	See for an end of
Medical or allied medical supervision provided at organized practices	None 85% (52)	ATC 8% (5)	EMT 7% (4)		ha dimos
Sports where physicians are in attendance	Football 67% (38)	Combination† 19% (11)	Wresting 2% (1)	None 12% (7)	
Physician coverage at road games	Always 39% (22)	>50% 33% (19)	<50% 18% (10)	Never 10% (6)	
Are JV athletes provided with the same physician coverage at games?	Yes 67% (37)	No 33% (18)			
Serves as the school athletic trainer	Coach 64% (39)	ATC 8% (5)	Other* 28% (17)		
Provides immediate care for injured athletes	Coach 84% (51)	ATC 8% (5)	Other* 8% (5)		
Responsible for prevention, care, and rehabilitation of athletic injuries	Coach 82% (50)	ATC 8% (5)	Other* 10% (6)		
Provides follow-up evaluation for injured athletes	MD 48% (29)	MD/Coach 14% (9)	Coach 23% (14)	ATC 5% (3)	Other* 10% (6)
Determines return to participation following athletic injuries	Coach 18% (11)	ATC 8% (5)	MD 74% (45)		
Type of training for noncertified athletic trainer	None 29% (16)	First Aid CPR 45% (25)	Coaching Education Class 27% (15)		
Are athletic injures recorded?	Yes 52% (32)	No 48% (29)			

* Other denotes noncertified AT, EMT, or PT.

+ Combination denotes football plus one other sport, ie, basketball, baseball, soccer, or softball.

accordance to the classification reported by Whieldon and Cerny.²⁸ Mild injuries were classified as the student athlete having missed 1 to 7 days; minor injuries, 8 to 21 days; and major injuries, more than 21 days to the end of the season. Injuries resulting in death or catastrophic outcomes were recorded separately.

In order to make a comparison between the situation in Hawaii and other states in the nation, we performed an extensive literature review on the status of medical coverage, sports medicine care, and changes in overall sports health care for secondary school student athletes in other states.^{1–3,9,12–16,20–25,27} In addition, we reviewed literature on injury rates^{4,6,10,11,17–19,22,26} and the impact of having qualified athletic trainers and athletic training facilities for secondary school student athletes.^{7,8,14,28}

The state's athletic director's association initiated an extensive lobbying effort, including recruitment of parents, coaches, school administrators, athletic trainers, physical therapists, lawyers, and physicians to meet with state legislators and eventually testify at legislative hearings. Because this process was targeted as an educational health and safety issue, the chairs of the respective house and senate education committees backed the project and introduced a series of bills to fund the hiring of 38 certified athletic trainers, one for each public secondary school in the state. Following introduction of the bills, a media campaign was launched on television and in newsprint. Sportscasters and newswriters were contacted and solicited to report the results of the needs-assessment studies, the national injury surveillance statistics, projected cost savings in health care and litigation due to reduction of potential liability and proper risk management, and the continuing status of the bills as they made their way through the legislative sessions.

RESULTS

The educational platform was very effective in creating a heightened awareness of the role of ATCs. We were able to establish that, although injuries were a standard part of participation, they could be reduced in incidence and severity if an overall sports health care program was implemented and if qualified athletic health care specialists were employed. In many ways, we were able to expand the breadth of knowledge for athletic health care among parents, coaches, athletic directors, and school administrators who participated in the educational classes/workshops. This resulted in the self-realization among participants that they were not properly trained to manage the scope of trauma and potential litigious situations that they were facing and would continue to face. In essence, we convinced the consumers that the current levels of sports health care fell far below the accepted standard of care for students participating in high-risk activities.

The results of the needs-assessment studies continued to strengthen our position that improvement of the current practices of sports health care was essential. The survey on practices of sports health care had an overall response rate of 61/61(100%). The findings indicated that a total of 19 703 (11 678 boys and 8025 girls) student athletes were actively participating in organized athletic programs. The Hawaii High

School Athletic Association is composed of 23 private schools and 38 public schools. Private school athletes accounted for 6993 (35%), while public schools accounted for 12 710 (65%) participants. Responses to specific questions concerning sports health care currently provided for high school student athletes within the state are presented in Table 1. There were significant differences (p<.05) on five questions between the public and private schools about sports health care for their respective student athletes (Table 2).

The results of the year-long injury surveillance study indicated that 38 public schools reported 2718 injuries. Since the purpose of the study was to persuade legislative funding, the study included only public schools. More than half (1538) of the injuries (57%) occurred in practice, and 1180 (43%) occurred during games. Male student athletes suffered 1766 injuries (65%) and female student athletes suffered 952 (35%). Varsity level players accounted for 2072 injuries (76%) and junior varsity players accounted for 646 (24%). Fewer than two injuries (1%) occurred to 13-year-old, 389 (14%) to 14-yearold, 840 (31%) to 15-year-old, 817 (30%) to 16-year-old, 633 (23%) to 17-year-old, and 37 (1%) to 18-year-old student athletes. In terms of injuries by sports, football and soccer had the highest incidence of injury rates at 1067 (39%) and 825 (30%), respectively. The ankle and the knee had the highest rates at 907 (33%) and 299 (11%), respectively.

Regarding injury severity, 2157 of the injuries (79%) could be classified as mild, 277 (10%) as moderate, and 284 (11%) as major. Of the 2157 mild injuries, 868 (40%) were treated with ice, 214 (10%) with first aid, 875 (41%) with tape, 28 (1%) with heat, and 172 (8%) received no treatment at all. For moderate injuries, 196 (70%) received ice treatment, 42 (15%) received first aid, 16 (6%) were taped, 2 (1%) received heat, and 21 (8%) got no treatment at all. For the major injuries, 197 (69%) were treated with ice, 61 (21%) received first aid, 10 (4%) were taped, one athlete received heat treatment, and 15 (5%) received no treatment at all. During the injury surveillance study, one athlete died because of a cardiac aneurysm, and one player suffered a nondisplaced fracture in his cervical spine.

The results of the newspaper and television media campaign were effective in maintaining the level of awareness of the sports health care issue throughout the year. Articles appeared in the sports section of the newspaper approximately every 3 weeks. At the beginning of the legislative session, the three major TV news channels ran features on the two needsassessment studies during the sportscast. Both the news and television media interviewed lawmakers, parents, coaches, and school officials about their perceptions of the importance of improved sports health care for high school student athletes. The public response continued to advocate and elicit endorsements for this project at the state legislative level. The overall results of this project culminated in legislative funding for the 1993–1995 biennium budget.

DISCUSSION

Organized high school athletic programs offer an opportunity for participants to experience cooperative learning, interactive

	Resp	oonse			
Question	Public	Private	DF	χ^2	р
Medical or allied medical supervision					
provided at organized practices:					
None	34 (32.4)	18 (19.6)			
ATC	0 (3.1)	5 (1.9)	2	10.89	.004
EMT	4 (2.5)	0 (1.5)			
Serves as the school athletic trainer:					
Coach	27 (24.3)	12 (14.7)			
ATC	0 (3.1)	5 (1.9)	2	9.10	.01
Other†	11 (10.6)	6 (6.4)			
Provides immediate care for injured					
athletes:					
Coach	34 (30.5)	15 (18.5)			
ATC	0 (4.4)	7 (2.6)	2	13.28	.001
Other†	4 (3.1)	1 (1.9)			
Responsible for prevention, care,					
and rehabilitation of athletic injuries:					
Coach	36 (30.5)	13 (18.5)			
ATC	0 (3.1)	5 (1.9)	2	14.26	.0008
Other†	2 (4.4)	5 (2.6)			
Provides follow-up evaluation for					
injured athletes:					
Coach	9 (9.3)	6 (5.7)			
ATC	0 (3.1)	5 (1.9)			
MD	19 (17.4)	9 (10.6)	4	14.56	.006
Coach/MD	8 (5.0)	0 (3.0)			
Othert	2 (3.1)	3 (1.9)			

Table 2. The Results of the Chi-Squared Contingency Tests for Provisions of Sports Health Care Provided by Public and Private Schools (observed responses reported with expected values in parentheses)

† Other denotes noncertified AT, EMT, or PT.

learning, quality adult mentoring, and fun. However, participation in organized athletics can also be accompanied by the risk of both minor and catastrophic injuries.^{4,6-8,10,11,17-19,22,26,28} Therefore, the benefits of organized athletic programs can outweigh the potential risks only if high standards of overall health and safety (ie, sports health care) for the participants are considered. Furthermore, with approximately 1.3 million injuries occurring in organized high school athletics annually, and in consideration of the current litigious climate, there was a clear need to address this issue.^{12,22} In an attempt to address the issue of sports health care, many schools employ physicians and/or other qualified health care professionals to provide immediate care for injuries during games. However, it has been observed that injuries occur more often during practice than in games.^{8,19,22} These findings raise relevant questions about the need for qualified health care professionals to address the daily injury prevention, care, and rehabilitation of secondary school student athletes. In fact, many authors 7,8,14,28 suggest that when high school athletes have access to qualified athletic trainers and athletic training facilities, injury recovery time is rapid and unremarkable. These studies leave little doubt about the need for adequate medical care for the high school student athlete.

In the state of Hawaii, we examined the paradox described in the preceding paragraph and developed and implemented a plan to convince the state legislature that funding for athletic training services was a crucial part of the overall health and safety of public secondary school youths. In fact, our needsassessment studies indicated that in 52 of the 61 schools, there was no medical or allied medical supervision during periods of state-sanctioned, organized, supervised, high-risk activity (sports practice). Of the 38 public schools, 4 had an EMT present for practice and the remaining schools had no medical or allied medical supervision on site for these high-risk activities (Table 2). This represented a major health and safety concern, since 57% of our injuries (and approximately 66% of all injuries nationally²²) occur during practice.

Clearly, the quality of sports health care was unacceptable in 16 schools; those providing care for injured athletes had no educational training at all. Most acute injuries were treated improperly; 901 of the reported injuries (33%) were treated with tape, 31 were treated with heat, and 208 received no treatment at all. Even more astonishing is the fact that 15/208 (7%) of the injuries that received no immediate treatment were classified as major (ie, athlete missed > 21 days of participation). These figures provided strong evidence to convince state lawmakers, because they indicated that state employees were providing a service that they were not trained to provide and, in at least 1140 instances, student athletes had been treated in a contraindicated manner. Concurrently, the legislators were surprised that ATCs were recognized by the American Medical Association as allied health care professionals and that their

educational preparation was accredited by the same organization.

Our study further indicated that when those who served as athletic trainers (primarily coaches) did have educational training, it was limited to first aid, CPR, and/or 3 hours of a coaching education workshop (Table 1). In 1986, a national study had examined the knowledge of care and prevention of athletic injuries of individuals who were designated as the schools' athletic trainers.²⁴ In that study, the authors stated that "Professional incompetence is a phenomenon in today's society."²⁴ Their results further indicated that in the area of injury care "... possibly hundreds of incorrect decisions are made on a daily basis."²⁴ Our findings confirmed that this was also happening within the state of Hawaii and these facts became an integral part of the overall presentation to the state legislators.

In developing our strategy for convincing the state's lawmakers to fund positions for ATCs into the public schools, we again drew on comparisons with other states and school districts. In 1992, Lindaman¹⁵ indicated that the availability of certified athletic trainers at the secondary level in the state of Michigan was increasing, as compared with numbers from earlier studies. However, he also indicated that, although there had been an improvement, the level of quality and quantity of athletic trainers at the high school level was still inadequate. Lindaman¹⁵ further stated that schools with larger populations had the greatest percentage of athletic trainers. In contrast, our study indicated that the schools with certified athletic trainers (all private) represented only 19% of the total population, although two of the five schools did have a combined total of 2509 (39%) athletes participating in interscholastic sports. In essence, our findings indicated that the most prestigious private schools (which are not impacted by state funds) were addressing the needs of health care for their students by hiring ATCs on a full-time basis, whereas the public school students who depended on state-supported programs were exposed to grossly inadequate health care. This finding was presented to the state legislators as a clear case of discrimination and negligence, since a standard of care had been established for the private school students within the state (Table 2; p < .05).

Most interestingly, our request for the state legislature to appropriate funding to hire ATCs for all public secondary schools came at a time of severe fiscal restraint and a gubernatorial-mandated zero-growth state budget. Although it may have appeared reasonable to question this appropriation of funding, the sheer numbers of participants in organized high school athletics, combined with the potential risk of injury, mandated that the risk-to-benefit ratio be evaluated. In lieu of a 1986 \$6.3 million court decision (Thompson v Seattle Public Schools District) and the concern for cost-efficient health care,⁵ the major question that we addressed was how our state can afford to not provide quality sports health care for our secondary school students. In fact, during the development of our project, we discovered that a Hawaii public school student athlete had been rendered quadriplegic during football practice in 1989. The young man was currently in the process of suing the state for damages.

The needs-assessment studies (qualitative and purposeful descriptive research) that we performed allowed us to present

a clear case for funding athletic training positions in the state's 38 public secondary schools. These facts alone were important, but of equal importance was the planned presentation of findings to the legislators. Before the 1993-94 legislative session, the state's athletic directors had become convinced that hiring ATCs was a health and safety issue and that this would be their number one priority. In consideration of their powerful lobbying unit, the athletic directors approached the legislature and urged that Senate Bill 336, which asked for the appropriation for funding to hire athletic trainers in all of the state's public secondary schools, be introduced and supported. Therefore, what was happening in the state of Hawaii was not an issue of athletic trainers promoting their own profession and appearing "self-serving." It was an illustration of the athletic directors (consumers) expressing needs for their programs and demanding that the state's public secondary school student athletes have the same standard of care that the private school athletes were receiving. The overall cost of the program was estimated at more than \$1.4 million. In a clear show of support, the athletic directors were asked (during a legislative hearing) how they would spend a blank check for \$1.5 million; they replied in unison, "Hire certified athletic trainers!"

Although support was strong and the facts were clear, the state's severely depressed fiscal outlook still required consideration. Therefore, an alternative plan was developed to fund a 2-year pilot program to continue to show the need and the effect of hiring ATCs. The pilot program was developed to fund ATCs for 10 schools the first year and 5 schools the second year. A weighting system was developed on the basis of number of athletes, location to the nearest medical facility, existing facilities, number of sports, and geographic location (Hawaii has public schools on six different islands). The legislative intent was to objectively evaluate the effect of hiring ATCs in the public secondary schools and to expand the program as the state's budget increased. The project has been evaluated by the Department of Education evaluation branch. To date, this project has had a major impact on the health and safety of secondary school students. Following an evaluational presentation to the Board of Education (elected officials) in November 1994, the board unanimously voted to make placing an ATC in every public secondary school part of the governor's 1995 educational legislative package. In fact, when the 1995 governor's legislative package was released, only two educational issues were supported and addressed: school community-based management, and the need to have certified athletic trainers in all public schools.

In conclusion, the concerted efforts and teamwork of school principals, athletic directors, coaches, certified athletic trainers, physical therapists, physicians, lawyers, parents, and athletes persuaded the 1993–95 legislative session of Hawaii to fund \$1 167 000 over a 2-year period for an athletic training pilot program. Although many authors^{2,3,9,13,14,21} have expressed concerns similar to those of Dr. Lindaman, who stated: "I am appalled that the field of sports medicine has exploded over the last 15 years, but has left the medical care of the athletes participating in high school interscholastic sports truly lagging behind,"¹⁵ we believed that change could be facilitated in Hawaii. We used a multifaceted plan that included: 1) public

education, 2) state needs-assessment research, 3) national and state comparison information, 4) media coverage, 5) a wellplanned lobbying effort, and 6) the good fortune to permit Hawaii to take a positive step forward in the improvement of the overall health care and safety of its secondary public school student athletes. It is our hope that this project can aid other states and school districts to explore funding possibilities that will allow all secondary school youths to have access to appropriate health care when they participate in state and school-district-sponsored, organized sports activities.

ACKNOWLEDGMENTS

This study was partially funded by The Hawaii Youth Sports and Fitness Program and Hawaii Physical Therapy Inc. We would like to thank Mr. Edward Kiyuna, Executive Director of the Hawaii High School Athletic Association, for his support in this study.

REFERENCES

- 1. Athletic health care in the secondary schools. NATA News. Mar 1993:12-13.
- Brunet ME, Giardina D. Sports medicine in Louisiana: a survey of 242 high schools. *Louisiana Med J.* 1984;136:25–27.
- Cartland JE. Medical Care of high school athletes in Connecticut. Conn Med. 1985;49:645-646.
- Chandy TA, Grana WA. Secondary school athletic injury in boys and girls: a three part study. *Phys Sportsmed*. Mar 1985;13:106–111.
- Dear Mrs. Clinton. NATA responds to the president's health care task force. NATA News. Apr 1993;8–10.
- Garrick JG, Requa R. Medical care and injury surveillance in the high school setting. *Phys Sportsmed*. Feb 1981;9:115–120.
- Garrick JG, Requa RK. Girls' sports injuries in high school athletics. JAMA. 1978;239:2245–2248.
- Garrick JG, Requa RK. Injuries in high school sports. *Pediatrics*. 1978;61:465–469.
- Garth WP. Caring for Alabama's secondary school athletes. Ala Med, JMASA. Jul 1985;55:44–51.

- Grana WA. Summary of 1978–79 injury registry for Oklahoma secondary schools. J Okla State Med Assoc. 1979;72:369–372.
- 11. Hale RW, Mitchell W. Football injuries in Hawaii 1979. Hawaii Med J. 1981;40:180-182.
- 12. High school health care in the nation's capitol. NATA News. Mar 1993:6-7.
- Hoffman MD, Lyman KA. Medical needs at high school football games in Milwaukee. J Orthop Sport Phys Ther. 1988;10:167–171.
- Lackland DT, Tester JM, Akers PC, Hirata I, Knight RM, Mason JL. The utilization of athletic trainer/team physician services and high school football injuries. *Athl Train, JNATA*. 1985;20:20–23.
- Lindaman LM. Athletic trainer availability in interscholastic athletics in Michigan. J Athl Train. 1992;27:9–17.
- McCarthy MR, Hiller WDB, McCarthy-Yates JL. Sports medicine in Hawaii: care of the high school athlete in Oahu's public schools. *Hawaii* Med J. 1991;50:395–396.
- Moretz A, Grana WA. High school basketball injuries. *Phys Sportsmed*. Oct 1978;6:92–96.
- Moretz A, Rashkin A, Grana WA. Oklahoma high school football injury study: a preliminary report. J Okla State Med Assoc. 1978;71:85.
- Mueller FO, Blyth CS. North Carolina high school football injury study: equipment and prevention. J Sports Med. 1974;2:1–10.
- Nass SJ. A survey of athletic medicine outreach programs in Wisconsin. J Athl Train. 1992;27:180–183.
- Porter M, Nobles HB, Bachman DC, Hoover RL. Sportsmedicine care in Chicago-area high schools. *Phys Sportsmed*. Feb 1980;8:95–99.
- Powell J. Injury tool in prep sports estimated at 1.3 million. Athl Train, JNATA. 1989;24:360–373.
- Redfeam RW. Are high school athletes getting good health care? *Phys* Sportsmed. Aug 1975;3:34–39.
- Rowe PJ, Robertson DM. Knowledge of care and prevention of athletic injuries in high schools. *Athl Train, JNATA*. 1986;21:116–119.
- 25. Sherman B. A new approach to athletic training in southern Wisconsin high schools. *Phys Sportsmed*. Jan 1985;13:57–64.
- Shively RA, Grana WA, Ellis D. High school sports injuries. *Phys* Sportsmed. Aug 1981;9:46-50.
- Tucker JB, O'Bryan JJ, Brodowski BK, Fromm BS. Medical coverage of high school football in New York State. *Phys Sportsmed*. Sep 1988;16:120–130.
- Whieldon TJ, Cerny FJ. Incidence and severity of high school athletic injuries. *Athl Train, JNATA*. 1990;25:334–350.

How the best receiver in the game stays open.

Jerry Rice uses drug-free Breathe Right[®] strips to hold his nasal passages open and breathe easier. That can be a benefit for an athlete with a mouth guard, or a nasal problem. For more information or to place your order, call 1-800-233-6956.



Jerry Rice, 3-time Super Bowl champion.

🕨 Distributed exclusively by EZ Gard Industries, Inc. 🛛 © CNS 1995. Breathe Right strips have been shown to reduce nasal airflow resistance. Breathe Right is a registered trademark of CNS, Inc.



HEAL FAST ...

Do It All With DuoDERM[®] A *proven* viral barrier dressing[®]



Say goodbye to gauze. Because it's a whole new game with DuoDERM® CGF® Control Gel Formula dressings on your team for treating players' blisters, scrapes and burns from turf, track, mats and other playing surfaces. To find out why, call the ConvaTec Professional Services Department (800-422-8811).



Bowler PG, Delargy H, Prince D, Fondberg L: The viral barrier properties of some occlusive dressings and their role in infection control. Wounds 1993;5:1-8.

The Elusive Slipped Capital Femoral Epiphysis

Bruce C. Johnson, MEd, L/ATC; Lori A. Klabunde, FNP, PA-C, BSN

ABSTRACT: Slipped capital femoral epiphysis is the most common disorder of the hip in young adolescents. Although it is not completely understood, predictive indicators give clues as to who is at risk. Slipped capital femoral epiphysis need not be painfully disabling. Many children are quite active during an

active slip. Any child between the ages of 10 and 15 years presenting with thigh, knee, and/or hip pain and no special history of trauma should have a good hip examination to rule out slipped capital femoral epiphysis.

S lipped capital femoral epiphysis is the most common disorder of the hip in 10- to 15-year-olds.^{10,16,24} This disorder involves the progressive displacement of the proximal femur through the open growth plate (Fig 1). The femoral head remains in position while the epiphysis of the proximal femur slips in a posterior direction.^{6,14} Slipped capital femoral epiphysis affects males more commonly than females^{6,7,16,18,22} and occurs more frequently among blacks than whites,^{6,19,20} with bilateral slipping occurring in one fourth to one third of all cases.^{5,6,14,18,22}

Many athletic trainers and health care professionals evaluate, treat, and care for high school and college-aged athletes. Few athletic trainers, however, deal with 10- to 15-year-old athletes on a regular basis; therefore, the potential for error is greater when assessing the athlete for nontraumatic and growth plate injuries. Athletic trainers need to be aware of the potentially serious nature of slipped capital femoral epiphysis and of the possibility of missing the diagnosis of this condition.

THEORIES

Theories on why slipped capital femoral epiphysis occurs include trauma, inflammation, endocrine disorders, mechanical factors, and nutritional deficiencies.²⁴ None of these theories have been specifically proven, although the mechanical factors have received considerable attention recently.

During the period of rapid growth between the ages of 10 and 15 years, the proximal femoral epiphysis is a potentially weak spot. Its structure depends on the levels of sex and growth hormones in the body.^{10,15,18,22} Estrogens and androgens depress the proliferation of cartilage cells in the growth plate, possibly explaining why more males than females suffer from this condition.²⁰ Growth hormones have been known to cause widening of the proximal femoral epiphysis, which may explain why the growth plate is subject to shearing stress.^{9,10,17,22} The immediate cause of slipping of the proximal epiphysis appears to be mechanical, with shearing occurring under force.^{17,20} Trauma may also initiate slipping.⁹

Lori A. Klabunde is a family nurse practitioner and physician assistant at the Grand Forks Clinic.

The majority of affected persons are overweight, adding even more stress to the hip.^{1,4,5,9,10,14,20,24} Forces necessary to cause slipping were found to be within the physiologic range of the force that would be generated in overweight children, suggesting that purely mechanical factors may play a major role.⁹ The frequent occurrence of slipped capital femoral epiphysis in obese adolescents who are going through a growth spurt is suggestive of mechanical factors.²⁴ During normal gait, the force on the femoral head can be as high as 6.5 times body weight.⁹ During running, mechanical factors alone appear to account for shear failure of the proximal femoral growth plate in these patients, especially the obese.¹⁷ The average shear strength of the epiphyseal plate increases with age.⁹

The capital femoral epiphysis is prone to injury without major trauma.^{4,5,12,14,18,22,24} Frequently, patients with slipped capital femoral epiphysis localize their pain to the knee or medial thigh.^{4,6,7,10–12,14,18,22,24} This pain to the knee or medial thigh is caused by the femoral nerve innervation of the flexor muscles of the hip and the extensors of the knee. Skin sensation of the anterior and medial thigh are supplied by the femoral and obturator nerve.^{11,12,14,21} This conclusion comes from Hilton's Law, which states that the nerve that supplies the muscles and controls the movement of a part also serves the skin and other sensory surfaces connected with the part.²⁴



Fig 1. Slipped capital femoral epiphysis.

Bruce C. Johnson is an orthopedic assistant and athletic trainer at the Grand Forks Clinic at 1000 S. Columbia Road in Grand Forks, ND 58201.

Slipped capital femoral epiphysis is more likely to be missed during the initial examination if hip pain is absent and thigh pain is present.¹¹ Despite evidence that patients with slipped capital femoral epiphysis frequently complain of symptoms other than hip pain, the diagnosis continues to be missed. Many individuals with slipped capital femoral epiphysis who complain of persistent knee pain have had knee arthroscopy performed.^{10,14,24}

Becoming aware of the recognizable risk factors for the development of slipped capital femoral epiphysis equips the examiner to better assess the adolescent athlete. The largest single problem in the diagnosis of slipped capital femoral epiphysis is the lack of appropriate suspicion and experience in performing a proper hip examination.¹⁴

RECOGNITION AND EVALUATION

Slipped capital femoral epiphysis is most noticeable when comparing anterior-posterior pelvis x-rays with frog-leg lateral views (Figs 2 & 3). The activity level of those in the 10- to 15-year-old age group certainly predisposes them to this slippage. Patients may present in a variety of ways. Some will arrive nonweight bearing, while others will elicit scarcely a limp. The affected leg will usually appear externally rotated when compared to the contralateral side. Passive internal rotation will be resisted by the patient. During passive flexion of the hip, the affected hip will externally rotate more than the hip on the contralateral side (Fig 4).^{4,7,11,18} Comparing the contralateral side to the affected side is imperative.

Patients with slipped capital femoral epiphysis usually have weak hip abductors and the affected leg may appear shorter. When range of motion is performed, pain may not be elicited until the extreme ranges are reached. Walking will usually result in knee pain. Most signs of slipped capital femoral epiphysis evolve slowly over many months. When slipped capital femoral epiphysis is diagnosed or even suspected, nonweight bearing is recommended to assure that no more slippage occurs.^{10,20} The amount of displacement is generally related to the duration of symptoms.⁴ Immediate referral to an orthopedic surgeon is important.

CLASSIFICATIONS

The most useful way to classify slipped capital femoral epiphysis is by duration of symptoms. Acute, chronic, and acute-onchronic cover the parameters of this paper.^{6,7,11,14–16,20}

Acute Slips

In acute slips, the patient presents with a sudden onset of pain, 2 weeks or less in duration. Usually the patient is unable to bear weight on the affected limb. *The acute slip is an emergency that should be treated immediately*.

Chronic Slips

Chronic slips involve slow and gradual slipping with remodeling of the femoral neck. The leg is usually fixed in internal rotation. The patient walks with a waddling gait. The pain is dull and may be vague. Chronic slips are by far the most common.²⁴ Clearly, in many cases, the epiphysis heals while the slipped capital femoral epiphysis remains silent for a period of time.

Acute-On-Chronic Slips

Acute-on-chronic slips involve the gradual slipping of the epiphysis over the course of several weeks, causing pain and limping. A trivial injury or activity will cause a dramatic pain increase. *This type of slip is also an emergency*.

COMPLICATIONS

Two of the most common sequelae of slipped capital femoral epiphysis are avascular necrosis and chondrolysis.^{5,7,9,10,13,14,19,20,22–24} Detailed descriptions of each of these conditions extend beyond the scope of this paper, but a brief description of each is warranted.

Avascular necrosis involves a portion of the femoral head dying due to disruption of blood vessels that enter the femoral head just proximal to the epiphyseal plate.^{6,13} The main

Fig 2. AP view of pelvis showing slipped capital femoral epiphysis.



Fig 3. Frog-leg view of pelvis. Notice increased deformity of slipped capital femoral epiphysis.



Fig 4. Passive hip flexion involves much less abduction or external rotation in a normal hip (a) than in an abnormal hip (b). Be sure to compare passive flexion of injured and uninjured hips to determine if the injured hip has excessive abduction or external rotation.

supplier of blood to the superior weight-bearing portion of the femoral head are the lateral epiphyseal vessels.^{3,23} Chondrolysis involves the destruction of the articulating cartilage of both the femoral head and the acetabulum. A late complication of slipped capital femoral epiphysis is degenerative arthritis.^{2,4,7,8,10,12,14,22,24} The degree of complication will depend on the duration and extent of slippage.

TREATMENT

The goals of treatment are simple: stop further progression of the slipped capital femoral epiphysis and induce growth plate closure. Treatment is virtually always surgical^{4,7,16,22,23} with placement of one or more cannulated screws into the femoral head; less commonly, treatment can include open surgical procedures. Following surgery, growth plate closure occurs in approximately 6 to 18 months.²³ Crutch protection is continued with toe-touch weight bearing for a 6-week period.²⁰ Chronic and acute-on-chronic slipped capital femoral epiphyses are pinned in situ. In chronic cases, when muscle spasm has completely subsided and the hip has functional range of motion, crutch-walking is gradually discontinued over a 6-week period.²⁰ Sports can usually be resumed in 3 to 6 months following surgery in chronic cases. In acute slips,



Fig 5. Epiphyseal closure following in situ pinning of slipped capital femoral epiphysis.

full rigorous sports are withheld until the epiphysis has closed.^{13,14} The screws are removed after the epiphysis has closed (Fig 5).

CONCLUSION

Regardless of the somatotype or the "textbook" description of slipped capital femoral epiphysis, this condition can affect any adolescent and can occur without warning or injury. Any adolescent who presents with nontraumatic hip, thigh, or knee pain deserves a thorough examination of the hip as well as the knee. You may be surprised at what you find.

ACKNOWLEDGMENT

We would like to thank Dr. Brian Briggs of the Grand Forks Clinic for his encouragement of this project and the opportunity to have worked with him in Sports Medicine for the previous 12 years.

REFERENCES

- 1. Brenkel IJ, Dias JJ, Davies TG. Hormone status in patients with slipped capital femoral epiphysis. J Bone Joint Surg [Am]. 1989;71A:33–38.
- Brenkel IJ, Wise DI. Slipped capital femoral epiphysis. Br J Hosp Med. 1991;45:140–144.
- Brodetti A. The blood supply of the femoral neck and head in relation to the damaging effects of nails and screws. *J Bone Joint Surg [Br]*. 1960;42B:794-801.
- Busch MT, Morrissy RT. Slipped capital femoral epiphysis. Orthop Clin North Am. 1987;18:637–647.
- Canale ST. Fractures and dislocations in children—slipped capital femoral epiphysis. In: Crenshaw AH, ed. *Campbell's Operative Orthopaedics*. St. Louis, MO: Mosby Year Book; 1992;2:1149–1181.
- Canale ST. Fractures and dislocations. In: Canale ST, Beaty JH, eds. *Operative Pediatric Orthopaedics*. St. Louis, MO: Mosby Year Book; 1991:900–926.
- 7. Canale ST. Problems and complications of slipped capital femoral epiphysis. *Instr Course Lect.* 1989;38:281–290.
- Carney BT, Weinstein SL. Long term follow-up of slipped capital femoral epiphysis. J Bone Joint Surg [Am]. 1991;73A:667–674.
- Chung SMK, Batterman SC, Brighton CT. Shear strength of the human femoral capital epiphyseal plate. J Bone Joint Surg [Am]. 1976;58A:94–103.
- Crawford AH. Current concepts—slipped capital femoral epiphysis. J Bone Joint Surg [Am]. 1988;70A:1422–1423.

- 11. Kelsey JL, Acheson RM, Keggi KJ. The body build of patients with slipped capital femoral epiphysis. Am J Dis Child. 1972;124:276-281.
- 12. Ledwith CA, Fleischer GR. Slipped capital femoral epiphysis without hip pain leads to missed diagnosis. Pediatrics. 1992;89:660-662.
- 13. Morrissy RT. Principles of in situ fixation in chronic slipped capital femoral epiphysis. Instr Course Lect. 1989;38:257-262.
- 14. Morrissy RT, Selman S. Slipped capital femoral epiphysis. Orthop Nurs. 1991;10:11-20.
- 15. Oka M, Miki T, Hama H, Yamamuro T. The mechanical strength of the growth plate under the influence of sex hormones. Clin Orthop. 1979;145: 264 - 272
- 16. Ozonoff MB. Pediatric Orthopedic Radiology. 2nd ed. Philadelphia, PA: WB Saunders; 1992:293-301.
- 17. Pritchett JW, Perdue KD. Mechanical factors in slipped capital femoral epiphysis. J Pediatr Orthop. 1988;8:385-388.

- 18. Salter RB. Textbook of Disorders and Injuries of the Musculoskeletal System. Baltimore, MD: Williams and Wilkins; 1970:289-292.
- 19. Spero Cr, Masciale JP. Slipped capital femoral epiphysis in black children: incidence of chondrolysis. J Pediatr Orthop. 1992;12:444-448.
- 20. Tachdjian MO. Pediatric Orthopedics. 2nd ed. Philadelphia, PA: WB Saunders; 1990:2:1016-1063.
- 21. Tortora GJ, Anagnostakos NP. Principles of Anatomy and Physiology. 3rd ed. New York, NY: Harper and Row; 1981:319-321.
- 22. Turek SL. Orthopaedics-Principles and Their Application. 4th ed. Philadelphia, PA: JB Lippincott; 1984;2:1204-1208.
- 23. Weiner DS. Bone graft epiphysiodesis in the treatment of slipped capital femoral epiphysis. Instr Course Lect. 1989;38:263-271.
- 24. Wenger DR, Rang M. The Art and Practice of Children's Orthopaedics. New York, NY: Raven Press; 1993:331-371.

I-Track 2.0

I-TRACK SYSTEMS The Premier Injury and Facility Management Software

The high schools, colleges, clinics, and professional teams can't be wrong. I-Track is easy to use, thorough, and flexible enough to fit in any sports medicine facility. I-Track is designed and managed by certified athletic trainers with one goal in mind, to make the athletic trainer's job more efficient. Our users help I-Track stay ahead of the competition by informing us of the issues that are important to them.

I-Track Features

- User-defined con
- Password protec
- Quick entry trea
- Comprehensive
- SOAP note injur .
- Surveillance sys
- Customizable an
- Inventory manag

Version 3.0 is s

- Billing and estin
- Single user, netv versions availab
- Versions may be

	The Face Lagent Tulary	Treament Tebort Intentory Tound Window Helb
•		
nfiguration tables		Patient Initial Evaluation
tion		Subject Object Assmt Plan Survey Referral
tments	Injury	Last Name First Name MI SSN Player Code
medical histories	Date Injury BodyPart	WEIGHT NELLIE L 365-55-1324 NLWGOOBER
y evaluation entry	3/24/95 Arm Arm	Body Part Injured Side Injured Report Date Injury Date
tem	1/12/95 Other Achilles	
d standard reports	9/12/94 Humerus,Surr Ankle	Ant.Talofibular Lig. Sprain
rement	3/21/94 FX,Cervical Achilles	Secondary Injury Specific Structure Injured
ations of worth	4/20/93 Cervical Cervical 2/13/93 Contusion AC Joint	Ankle Effusion 🛨
and NDA NEL and On the Co		Roster Trainer Current Status
OIK, INDA, INFL, and On-the-Go		Soccer(W) ± James Higbe ± Out ±
e		When Where Activity
customized for your facility		Pres Missed Cames Missed Date On ID. Date Office. Date Date
		4 0
	+ +	
cheduled for release Summer '95. F	For more information a	out I-Track, contact James Highe, A.T., C.
Free demo disks	available - Please speci	v version
1 000	775 76	
1-800	J-125-20	4. CVUIBIT
Computer Ma	nagement Sci	ences. Inc. VISIT NATA EXHIBIT
8133 Baymeadows	s Way Jacksonvill	e. FL 32256

Tired of neoprene problems?



Good Compression

Thin

Breathable

Hypo-allergenic--No reported skin reactions

No odor

Longer life

4 to 5 times stronger

is not

Good compression

NEOPRENE

Bulky

Hot

Skin Reactions

Smelly

Loses stretch

Easily torn

This is the bottom line,

Skin offers solutions not problems.

call to try a Bio Skin sport support.

See us at the NATA Meeting in June, Booth #1038



Changes in Athletic Training Education as a Result of Changing From NATA-PEC to CAAHEP

Audrey L. Mathies, MEd, ATC; Craig R. Denegar, PhD, ATC, PT; Robert W. Arnhold, PhD

ABSTRACT: The purposes of this study were to: 1) identify the major differences between the CAAHEP athletic training educational essentials and NATA educational essentials, and 2) address the potential impact of those changes on educational programs. Three of the five athletic trainers on the JRC-AT responded to an eight-item questionnaire. Responses from the survey were compared and contrasted. CAAHEP accreditation guidelines will permit more flexibility in teaching methods than did the NATA guidelines. CAAHEP does not mandate a minimum of 800 hours of clinical experience, but the NATA Board of

he governing body for undergraduate athletic training educational programs has changed from the National Athletic Trainers' Association (NATA),³ which approved programs through the Professional Education Committee (PEC), to the American Medical Association's (AMA) Commission on Accreditation of Allied Health Education Programs (CAAHEP),⁴ formerly the Committee on Allied Health Education and Accreditation (CAHEA). The NATA established a working relationship with the AMA in an attempt to upgrade undergraduate athletic training education through reorganization of curricula, coordination of educational activities, and improved use of faculty and facilities.¹ Change produces anxiety and uncertainty, and we were concerned about the effect of this change on personnel, students, and institutions associated with NATA-approved undergraduate athletic training education programs. In this study we attempted to: 1) identify the major differences between the CAAHEP athletic training educational essentials and NATA essentials, and 2) address the potential impact of those changes on educational programs.

OVERVIEW OF THE CAAHEP ACCREDITATION PROCESS

CAAHEP, which accredits 28 allied health professions, was formed by the AMA to govern and enforce compliance with nationally accepted educational standards established by professionals in the field and to ensure quality education.⁶ Ac-

Robert Arnhold is a professor in the Department of Physical Education, at Slippery Rock. Certification requires the completion of 800 hours before taking the certification exam. CAAHEP policies regarding fair practice and nondiscriminatory policies were believed to be more strict, thus assuring that students are not misused in a service capacity, and are exposed to a variety of male and female sports. Financially, the accreditation fees were increased. Long-term changes were anticipated as: 1) administrative and content essentials being weighed separately, 2) departmental move to medical or allied health departments, and 3) increased academic responsibilities for program directors.

creditation is a voluntary procedure, and programs seeking CAAHEP accreditation must complete a number of AMAdesignated procedures.⁶ The first step consists of completing an application for accreditation along with a self-study report.⁶ The self-study report is a "documented written account of the self-evaluation outcomes necessary to indicate substantial compliance with the essentials."⁶ A JRC-AT committee member reviews the completed self-study report and decides whether the program will be granted a site visitation.⁶

A site-visitation team comprised of two or more health care professionals is sent to the sponsoring institution to validate the contents of the self-study report.⁶ The completed site visitation report is sent to the chief executive officer and program director of the sponsoring institution. This sponsoring institution has an opportunity to review the conclusions, make comments, and correct any factual errors.⁶ The self-study report and visitation team report are reviewed by a CAAHEP subcommittee, which meets three times a year to consider applications for initial or continuing accreditation.⁶ The subcommittee then makes a recommendation regarding the accreditation status of the educational program. They may find an institution's educational program in complete compliance, partial compliance, or noncompliance with the standards.

Based on these findings, a program may receive accreditation for 0 to 7 years. Athletic training educational programs have had to go through this process for new or continuing accreditation beginning with the 1993 school year.¹

OVERVIEW OF THE NATA APPROVAL PROCESS

The NATA approval process consisted of providing a three-part self-evaluation document and a site visitation.³ The self-evaluation included specific questions for the Dean/ Department Chair, Program Director, and Athletic Director to answer. The completed document was sent to the NATA-PEC

Audrey L. Mathies is an athletic trainer currently working in northern New Jersey.

Craig R. Denegar is a professor in the School of Physical Therapy, Slippery Rock University, Slippery Rock, PA 16057.

for review. After analysis of documentation, the PEC decided whether or not the institution met the program criteria. Institutions meeting the criteria were granted site visitations that were used to validate the information in the self-evaluation. Program approval lasted for 5 years, but programs were required to submit annual reports regarding essential compliance from the Program Director.³ Programs not meeting the criteria throughout the 5 years were placed on probation for 1 year to allow for deficiency correction.³ NATA had a 2-year preapproval process for first-year programs before their being granted full approval.³

METHODS

We chose a qualitative approach because of the nature of the data and the need to provide a standardized framework for the specific questions that emerged as the project progressed.⁵ In the first step, we reviewed CAAHEP and NATA athletic training educational program essentials published by NATA³ and the AMA.⁴ We placed each essential on index cards so the similarities and important differences could be identified (see Table).

Step 2 consisted of developing an eight-item questionnaire from the comparison of NATA and CAAHEP athletic training educational essentials focusing on three areas: 1) resources, 2) curriculum, and 3) operational policies. The five athletic trainers on the AMA's Joint Review Committee for Athletic Training (JRC-AT) were selected for this study because of their involvement in establishing the CAAHEP essentials. We mailed the questionnaire, a letter explaining the study, and a consent form to each subject. A standard, open-ended telephone interview⁵ addressing each item on the questionnaire was conducted in the Fall of 1992 with those who consented to participate. Finally, we transcribed the comments and compared the responses.

RESULTS

Three of the five JRC-AT members who received the questionnaire consented to be interviewed. Their responses are summarized below.

Question #1

CAAHEP recognizes the program director as the primary program administrator. Because the athletic training faculty and staff are relatively small (three to five individuals), the CAAHEP accreditation could create an undue burden on the program director and staff. What impact will completing the CAAHEP self-study report have on an institution?

Response. Three different responses were given. One respondent stated that the CAAHEP self-study report would place additional burden on the program director because it required more in-depth work coordinating institutional personnel to successfully complete the self-study. Another believed that the committee effort would allow for a lighter workload for the program director. The third respondent thought that there would be minimal impact in terms of time commitment and workload. He thought the first year would be most difficult because the CAAHEP style self-study is a new experience and is in a different format than the report previously required for accreditation. He also said that the greatest impact was expected to result from the institution's review of the instructional methods used in the athletic training curriculum.

Question #2

CAAHEP specifies that programs are required to have a sufficient number of faculty, involvement of a variety of medical specialists and allied health personnel on a full- or part-time basis, adequate clerical staff, and an adequate library facility. What will be the impact of changing these essentials from recommendations by the NATA to CAAHEP mandates with regard to human resources? What does CAAHEP expect in regard to instructional material (ie, modalities and isometric/ isokinetic equipment) in order to satisfy accreditation essentials as compared to NATA essentials? What does CAAHEP expect regarding library resources in order to satisfy accreditation essentials as compared to NATA?

Response. All respondents believed that there would be a minimal impact regarding human resources. The only possible change expected was in the area of additional clerical staff. Respondents were in agreement that instructional material requirements, especially in the area of modality exposure and library resources, would remain the same as they were under NATA approval.

Question #3

What will be the financial impact of fulfilling the CAAHEP requirements for accreditation as compared to the NATA requirements for the costs of accreditation application, on-site visitation, and developing the self-study (ie, additional personnel and release time)?

Response. The application fee to CAAHEP is a one-time fee of \$200. There are two additional annual fees: 1) a \$200 institutional fee which will be used by the AMA (CAAHEP) to defray the expenses for accrediting any number of programs at an institution (this fee covers all CAAHEP-accredited programs at an institution), and 2) a \$250 fee used to support the JRC-AT office. All respondents agreed that the cost of the on-site visitation would remain the same as the NATA. That cost consists of the expenses (travel, lodging, meals) to accommodate the two-member evaluation team. In addition, one respondent stated that some program directors may require release time during the first semester of the self-study process.

Question #4

A purpose of the CAAHEP accreditation is to assess outcomes of the educational experience (ie, documentation of course goals and objectives, and verification of student achievement). NATA focuses on an assessment of process (ie,
noting where each competency is addressed within the curriculum). How do you see this change impacting the operational policies of programs?

Response. Two respondents agreed that the basic requirements and expectations of the curriculum remained the same, but stated that the methodology of fulfilling the requirements has changed. One believed that CAAHEP would not place any more emphasis on the assessment of outcomes than NATA had. The other believed that CAAHEP was less dictatorial than NATA and that the institutions will have to determine how to best educate their students and assess their students' achievements on curricular essentials. The third respondent believed that more time and effort on the part of the program director and institution were required to demonstrate how the program's goals and objectives were being met.

Question #5

CAAHEP requires explicit and defined fair-practice policies regarding athletic training programs (ie, nondiscriminatory practices, performance of service work, student costs and credits of the program, health and safety of patients, student and faculty grievances). NATA does not address these issues. What impact, if any, will this have on accreditation by CAAHEP? Will certain essentials carry more weight than others?

Response. One respondent stated that there would be minimal impact on programs as long as they are housed in colleges, since policies addressing these issues already exist within most educational institutions. The other two respondents believed that these essentials could have an impact on athletic training programs. The emphasis was directed toward the assurance that students are not being misused in an athletic training service capacity. Misuse was defined as students being used in place of qualified, regular employed, staff members. Programs will be required to ensure that students have equal opportunity to work with a variety of male and female athletic teams. It was also stated that programs restricting females or males from covering specific sports will be in breach of the essentials. Two respondents believed that all the essentials would carry the same weight. One added that CAAHEP can reapprove programs for varying lengths of time, for a maximum of 7 years, depending on the seriousness of the violation or noncompliance. There was speculation that the JRC-AT may attempt to separate administrative noncompliance from content noncompliance. A separation could occur because CAAHEP has three accreditation levels: compliance, partial compliance, and noncompliance. The third respondent believed that CAA-HEP would allow the JRC-AT to place more weight on the more important essentials.

Question #6

NATA mandates an 8:1 student-to-certified athletic trainer ratio and an 800-hour minimum clinical experience. CAAHEP only recommends an 8:1 ratio and an 800-hour clinical experience. How will CAAHEP assess the effectiveness of the guidelines as compared to the NATA mandates?

Response. One respondent believed that the question could not be answered since the profession has set the certification exam as a measure of student achievement. The on-site visitation will place greater emphasis on assessing students, since institutions will be required to demonstrate how they met the designed objectives. Student achievement will be assessed by the on-site visitation through student interviews, results on the certification exam, and feedback from graduates. The Board of Certification requires 800 hours of clinical experience before students sit for the certification exam. Programs should follow the CAAHEP recommendations so that students will receive an adequate athletic training educational experience.

Question #7

What criteria will affirm that the stated CAAHEP educational goals are being met to develop a "qualified" athletic trainer?

Response. All respondents agreed that the profession would use the certification exam as the objective criterion to assess qualification as an entry-level athletic trainer. With regard to individual institutions affirming that their essentials, goals, and objectives are being met, one respondent thought that the CAAHEP process was too young a process to state specific quality assurance criteria. Another thought that the quality control would consist of comments from program graduates and feedback from their employers. The third respondent believed that the institutions would have to identify where the students were being exposed to the 191 documented athletic training competencies.²

Question #8

What other changes within the accreditation essentials, if any, do you see having a major impact on the institutions or programs?

Response. All respondents agreed that institutions will have greater freedom to develop programs that meet the essentials. They believed this will have the most significant impact on the athletic training programs. On a larger scale, the respondents had differing views. One believed that CAAHEP accreditation would

Important Differences Between NATA and CAAHEP Athletic Training Education Program Essentials and Standards

1. NATA self-study report was completed, for the most part, by the athletic training program director. CAAHEP emphasizes committee involvement in the completion of the self-study.

- 3. The focus of program review by NATA was on educational process. CAAHEP review places more emphasis on outcomes of the educational experience.
- 4. CAAHEP's statement on fair practice policies is more explicit than that of NATA.
- 5. NATA and CAAHEP have different policies regarding financial obligations for institutions.

^{2.} Some mandates under NATA are recommendations under CAAHEP (ie, 800-hour clinical experience) and some recommended practices are now mandated (ie, issues of human resources).

allow athletic training programs to be moved to the medical field or allied health area and away from physical education, and that programs would be in a better position to compete for grant money. Another thought the institutions would have more flexibility and freedom for creativity in program development. The third thought that the program directors with clinical responsibilities would be forced to accept more academic responsibility, and that eventually all program directors would become full-time academicians with experience as clinical instructors.

DISCUSSION

According to the respondents, the CAAHEP-accreditation process is designed to give institutions the freedom and flexibility to educate students based upon their own institutional philosophy as long as they can demonstrate that the CAAHEP essentials are being met. Institutions sponsoring undergraduate athletic training programs are required to provide the JRC-AT with a self-study report documenting where and how the essentials are addressed and being achieved. Unlike the NATA self-study, which was prepared by the athletic training program director, the CAAHEP self-study is to be conducted by a faculty committee.

Resources

The change from an individual project to a committee effort is not anticipated to be more difficult for the program director. The only additional burden that the respondents believe will be placed on the program director will be a time commitment during the year before the school's first JRC-AT on-site visit. The first year may require that he/she has additional release time to coordinate the self-study committee. There is no indication that additional personnel will need to be hired to assist in the process.

There will be either a \$250 or a \$450 increase in the cost of maintaining accreditation, depending on whether the institution currently sponsors other CAAHEP-accredited programs. The increase to a \$250 annual fee to support the JRC-AT was initiated to eliminate the use of NATA membership dues to cover accreditation expenses. The other direct institutional expense is the cost of hosting the two on-site evaluation team members for approximately 2 days, which remains the same as the NATA-approval process.

Respondents did not anticipate a direct financial impact on institutions for additional human resources. The human resources addressed in the essentials beyond the athletic training faculty and staff could be met in an informal manner through seminars, guest speakers, and clinical visitations. Institutions will not be expected to purchase all the instructional materials listed within the CAAHEP essentials, but must make arrangements for students to be exposed to the equipment. This is also true of library resources. Expectations of library resources will remain the same as with the NATA approval requirements.

Curriculum

A general conclusion by the respondents was that the NATA was more dictatorial in their essentials than is CAAHEP. The

termination of the requirements for an 8:1 student-to-certified athletic trainer ratio and a minimum of 800 hours of clinical experience does not appear to be a major concern of the JRC-AT. Institutions now have flexibility to use whatever student-tocertified athletic trainer ratio they feel comfortable with, but must document the outcomes of the clinical experiences. The impact of recommending, rather than mandating, at least 800 hours of clinical experience is expected to be minimal due to the continued use of the competency checklist and the NATA certification exam prerequisite of 800 hours of clinical experience. The competency checklist was designed by the NATA to specify entry-level skills and knowledge and to prepare students to challenge the NATA certification exam.3 The criteria that will be assessed by the JRC-AT include graduation rates, scores on the national certification exam, and interviews with students, graduates, and initial employers. The athletic training profession has determined that successful completion of the certification exam ensures that a student has met the criteria as an entry-level athletic trainer.

Operational Policies

The respondents anticipated that the fair practice policies mandated by CAAHEP would impact programs restricting selected students from working with certain sports. The other impact of the change in accreditation bodies was the potential to weigh essentials under the CAAHEP structure. Respondents indicated that institutions will have to ensure that students are not being misused in the provision of athletic training services and are exposed to a variety of male and female sports. A breach in this essential or any essential could render a program in partial or noncompliance. The different categories of accreditation allow the JRC-AT to provide a future separation of administrative from content essentials.

In conclusion, we do not anticipate the change from NATA approval to CAAHEP accreditation to have a major impact on existing NATA-approved undergraduate athletic training programs. There will be a small increase in fees, a greater emphasis on educational outcomes, and the requirement of a more detailed self-study. We do not anticipate substantial changes within programs, but we do envision an increase in administration and faculty involvement. We believe program directors should welcome a complete and in-depth self-study because it allows them the opportunity to pursue new and creative approaches to the education of future athletic training students.

REFERENCES

- Behnke R. NATA "approved" to CAHEA "accredited": the transition. NATA News. Feb 1991;3:4–5.
- Competencies in Athletic Training. Dallas, TX: National Athletic Trainers' Association; 1992.
- Guidelines for the Development and Implementation of NATA Approved Undergraduate Athletic Training Education Programs. Rev ed. Dallas, TX: National Athletic Trainers Association; 1988.
- Joint Review Committee on Education Programs in Athletic Training Accreditation Essentials. Chicago, IL: American Medical Association; 1992.
- Patton MQ. Qualitative Evaluation Methods. Beverly Hills, CA: Sage Publications; 1980:22,180.
- Rosenthal J, ed. Accreditation Manual. Chicago, IL: American Medical Association; 1991.



See Us At ACSM 42nd Annual Meeting Booth #533 and NATA 46th Annual Meeting Booth #417

STRETCH TAPE AVAILABLE

No gapping or looping Aggressive zinc oxide adhesive High tensile strength Full use down to the specially treated core Available in 71/2 yard and 5 yard lengths Available in 1", 11/2", 2" and 3" widths Made in USA

Please call (508) 686-8659 or Fax (508) 686-1141 For your nearest Jaybird & Mais distributor

Jaybird & Mais, inc.

ATHLETIC TRAINERS PRODUCTS

Manufacturing

360 Merrimack Street Lawrence, MA 01843 Tel (508) 686-8659 Fax (508) 686-1141 Sales Office 38 Harold Street Tenalfy, NJ 07670 Tel (201) 569-1500 Fax (201) 569-3774

Management of Sports-Induced Skin Wounds

Danny T. Foster, MA, ATC; Laura J. Rowedder, MS, ATC; Steven K. Reese, MS, ATC

ABSTRACT: Skin wounds are common in sports but are rarely documented by the certified athletic trainer. The literature is unclear about wound types, and none of the articles reviewed reported frequencies. The purpose of this paper is to discuss the frequency of common athletic skin wounds and their specific management. Management of skin wounds can sometimes be problematic. Hydrogen peroxide has been used on wounds since 1947, yet some researchers report that hydrogen peroxide and iodophor solution can delay or interfere with wound healing, or cause damage to the wounded area if use is intense and prolonged. Occlusive dressings have been re-

S kin wounds are frequent among athletes and other exercisers.^{2,3} They occur regularly but usually have little effect on athletic performance; therefore, details about skin wounds among athletes are limited. It appears that athletic trainers (ATCs) did not formally report their experiences with athletic wounds until the 1993 OSHA regulations helped to identify ATCs as an at-risk group.^{7,15,28,34,36} Because ATCs provide on-site health care services, ^{17,33,39} they are the primary managers of acute care for sports-induced skin wounds.

We initially reviewed the literature concerning skin wounds, cleansing agents, and dressings to learn more about how to decrease the risk to athletic trainers as they come into physical contact with an athlete's body fluids and tissues while managing wounds. As a result of the review, however, we became interested in the most effective and efficient wound management technique. Ineffective management may contribute to wound infection or may compromise physical performance.

WOUND FREQUENCY

Few authors report frequency distributions for skin wounds. In 1948, Thorndyke stated, "Without any doubt the most common inflammatory reaction that is encountered in the training of athletes, is the common ordinary blister."³⁸ We could find no other author in the athletic training literature who has commented as clearly about the frequency of wounds.^{2,3,9} Our review of the literature revealed that the terms "often" and "common" described frequencies for all skin wound types except punctures, which occurred "rarely."

Steven K. Reese is an athletic trainer at the Waukesha Sports Medicine & Physical Therapy Center in Waukesha, WI. ported to have considerable advantage in maintaining a moist wound bed and in decreasing healing time. Infection rates beneath occlusive dressings, however, are similar to those associated with other types of dressings. Complications to wounds, with or without the use of occlusive dressings, such as keloids and seborrheic dermatitis, occur in low frequencies. Due to a lack of specific information about sports-induced skin wounds and their management, we recommend that standardized documentation for common wounds be developed along with further study of techniques for management.

In an attempt to assign numerical statistics to the above descriptions, we found no other frequency reports. Our impressions about wounds may be vivid, but our knowledge is vague. We do not know how frequently skin wounds occur, nor how they occur. We do not even know individual characteristics about many wound types that might guide us in developing prevention strategies. If skin wound frequencies are high, the risk of ATC exposure to biohazards is also high. ATC time commitment to, and supply of resources for management and follow-up, must also be substantial. Efforts to record wound care practices may lead to the development of direct wound care studies and standardized documentation.

TYPES OF WOUNDS

Based on empirical evidence, four skin wound types occur frequently in athletics: abrasion, blister, incision, and laceration. Our discussion focuses on abrasions and blisters.

The athletic training literature^{2,3,9} indicates that both abrasions and blisters occur when shear stress is applied to the skin. According to the literature on dermatology, blisters occur when the skin is wet.³⁷ Athletes suffer these two wound types when they slide across playing surfaces or slide within their shoes.

Abrasions

Abrasions typically are categorized into two subgroups: Partial-thickness wounds,¹ wherein the epidermis or superficial dermis is abraded or removed, and full-thickness wounds, wherein skin is removed down to and sometimes including the subcutaneous fat layer.¹⁰ Wound healing studies generally address one or both of these categories.

Blisters

Sulzberger and co-workers³⁷ produced skin blisters in naval cadets using linear rubbing and twisting or rotating machinery.

Danny T. Foster is Program Director of Athletic Training Education and Associate Director of Athletic Training Services at the University of Iowa in Iowa City, IA 52242.

Laura J. Rowedder is the Head Athletic Trainer at The Northwestern College in Orange City, IA.

Intact fluid-filled blisters were difficult to produce except on the palms and soles. Other body areas targeted for blistering were the back, buttocks, shins, forearms, upper arms, and thighs. In these areas, abrasions rather than blisters were produced. The specific damage associated with a blister seems to arise from friction combined with moisture. Sulzberger³⁷ added moisture, in very small increments, to the rubbing or twisting. He reported that as soon as moisture was present, friction at the skin surface gradually increased to a maximum. These findings are important in relation to the role of sweating and the nature of the material worn next to the skin. The researchers concluded that the production of a blister versus that of an abrasion varied with skin thickness; the palms and soles are more likely to blister due to their thick outer stratum corneum or horny layer. This finding was inconsistent, however, within the same person and the same body part.

WOUND CLEANSING

Initiation of wound care is typically marked by cleansing the wound and surrounding skin.⁶ In the preparation and cleansing of wounds, ATCs should observe universal precautions. Infection in an open injury poses a potentially serious problem. Complications associated with infection are: 1) tissue damage, 2) foreign body contamination, and 3) bacterial inoculation.^{6,20} The principles of wound management are designed to prevent further bacterial inoculation and to debride and cleanse the wound of necrotic tissue and foreign material.^{6,11}

Athletic trainers apply special solutions and wash with water or other agents to prevent infection, debride wound material and tissue, and cleanse the surrounding intact skin.^{2,3,9} Hydrogen peroxide solutions have been used since 1947⁶ to reduce bacterial contamination and to enhance the physical debridement or cleansing of a wound. Studies on the effects of these and more recently developed agents for wound healing began in the 1970s.

Solutions

In 1991, Gruber et al¹⁶ treated partial-thickness wounds with acetic acid (.25%), provodone-iodine (Betadine), or hydrogen peroxide (3%) four times daily. A control wound was treated with normal saline. They found a shorter time to full healing with the hydrogen peroxide-treated group and no difference in the other two solutions from that of normal saline. They observed wound healing by gross visual inspection. These investigators noted complete epithelialization when they saw a pink color at the wounded area and no scab. This visual method of determining healing is common in skin wound research and relevant to our clinical use. However, the authors noted that the peroxide-treated wounds developed air-filled blisters. Further, they suggested that if the wounds were treated this intensely with peroxide for longer than 4 days, the blisters would have ulcerated. Finally, at 3 months, these researchers found no gross differences in pigmentation or texture among wound sites, regardless of treatment.

Neosporin ointment (Burroughs Wellcome Co, Research Triangle Park, NC) was developed to prevent further bacterial inoculation and has been studied by Welsh⁴⁰ for its effect on wound healing. Welsh showed that Neosporin did not delay or speed healing.

A related topical agent to Neosporin, Polysporin ointment (Burroughs Wellcome), has two antimicrobial agents: bacitracin and polymixin B sulfate. These agents are also found in Neosporin. After separating the two compounds in Polysporin, Eaglstein¹¹ reported that the use of bacitracin alone stimulated wound healing; neither polymyxin B sulfate nor Polysporin in compound affected wound repair.

Creams

Another antimicrobial agent often prescribed for wounds is Silvadene Cream (silver sulfadiazine). Welsh⁴⁰ reported that Silvadine was less effective than Betadine in reducing wound healing time. He compared the two cleansing agents without a control. Since Betadine ointment has been shown to be ineffective in decreasing healing time compared to controls, we hypothesize from Welsh's work that Silvadene either may interfere with re-epithelialization or may alter acute responses in some way.

Welsh⁴⁰ also reported significant bacterial reduction with the use of Johnson & Johnson First Aid Cream (Johnson & Johnson, New Brunswick, NJ) compared with Camphophenic gel (Winthrop Consumer Products, New York, NY). However, Camphophenic was thought to interfere with wound healing. First Aid Cream did not affect the rate of healing compared to a control.

Lotions and Soaps

Eaglstein et al¹¹ conducted studies on numerous topical agents used in wound antisepsis. They identified lotions containing zinc soap, oil-in-water cream, Neosporin, Silvadine, and Pan Oxyl (benzoyl peroxide) lotion (10% and 20%). Each of these agents accelerated epidermal healing when compared with controls. As noted here, Eaglstein's results were different from previous studies. Conflicting results among studies may be related to the common use of study specimens from different animal species. Although similar to monkey and pig skin as used in many studies, Montagna³⁰ showed that human skin is unique. In the absence of direct human skin comparisons, results of these studies should be interpreted with caution.

Ongoing wound studies have contributed to our knowledge of topical cleansing or antiseptic agents and their toxic effects on a variety of wounds. Through the early process of normal wound healing, the barrier properties of the wounded area are compromised. During the first 10 days, for example, the wound site may be susceptible to the toxic effects of the cleansing and antiseptic agents, since they are now more easily absorbed through the thin wound epithelium. The outer layer of cells, called stratum corneum, is needed to maintain the normal barrier function of the skin.^{18,30} Due to the ready absorption of toxicants when new skin with just a few layers or cells covers a wound, Betadine is one of those topical agents that dermatologists recommend to use with caution. Caution is especially important when treating patients with pre-existing thyroid or renal conditions.^{11,16,31,40} Since skin wounds are missing the stratum corneum barrier, vehicles or topical bases which are inactive on undamaged skin might have biochemical effects on wounded skin. Sometimes cleaning agents (ie, detergents and soaps) that are effective in retarding bacterial growth become toxic when applied to the altered physiology of the healing wound. The concentration of alkalines in soap or combinations of other compounds such as camphor or alcohol act as toxic agents to wounded skin.¹² Mild Ivory soap, in contrast, has antibacterial effects similar to Betadine but does not interfere with wound repair.¹²

WOUND DRESSING

Once the initial cleansing, debridement, and antiseptic procedures have been completed, the next step is to cover the wound. Acute, bleeding wounds are covered, even if they stop bleeding, in order to prevent further wound inoculation.^{2,3,6,8,20} Coverings for wound compression to stop bleeding and those that provide a mechanical barrier are usually one and the same.

Reports on dressings have only recently been updated and exclusively address occlusive dressings.²¹ A broad spectrum of occlusive dressings has been commercially available for the past 10 years. Some of these were developed in response to the fear of cross-contamination of HIV via open wounds,^{7,11} and some from wound-healing studies, which support the principle of "moist wound healing."^{10,13,18,21,25,28,42}

Athletic training literature promoted moist wound healing before the 1950s.⁹ Some advantages to skin healing beneath occlusive dressings have been recognized in the medical literature for over 20 years.⁷ A moist versus a dry wound environment was evaluated in 1975 by Gruber et al,¹⁶ who reported that the moist environment required 3 days less to reach wound-healing criteria. Despite this advantage, fear that the moist environment beneath an occlusive dressing would produce more infections seemed to retard the commercial development of these dressings until recently.²⁰

For purposes of this discussion, occlusive dressings are those that retain moisture in healing tissues. Semi-occlusive dressings readily accumulate moisture vapor under the dressing. Examples of commercially available dressings are shown in the Table.

Composition and	Trade	Names	of	Occlusive	Dressings
-----------------	-------	-------	----	-----------	-----------

Composition	Trade Name
Polyurethane films	Op-Site Tegaderm Bioclusive*
Polyethylene oxide hydrogel with polyethylene film backing	Vigilon
Hydrocolloid particles (gelatin and pectin) in a hydrophobic polymer	DuoDERM

Occlusive dressings increase the speed of healing in both acute and chronic wounds.^{11,34} Winter⁴¹ and Hinman¹⁸ showed that shallow wounds epithelialized faster beneath a plastic film than when the wound was allowed to air-dry. Occlusion increased epithelialization in: human incisions treated with Saran wrap (Dow Chemical Co, Indianapolis, IN); human donor sites treated with Tegaderm (3M Health Care, St Paul, MN) or Op-site (Smith and Nephew Medical, Ltd, Memphis, TN); shallow wounds treated with Vigilon (CR Bard, Inc, Murray Hill, NJ) or Duo-DERM (Bristol-Myers Squibb Co, Princeton, NJ); and dermabrasions, excisions, and scalp transplants treated with Vigilon.

According to some researchers, the rate of acute wound epithelialization increases by 30% to 45% beneath occlusive dressings^{10,34} when compared to nonocclusive dressings. What factors are present with occlusive dressings that account for the increased rate of epithelialization? Researchers^{10,18,34,42} cite the following important factors: 1) moist wound bed providing an easier route for epidermal migration, 2) increased oxygen partial pressure, 3) enhanced availability of growth factors, 4) favorable effects of microflora, and 5) maintenance of the electrical potential between wounded and nonwounded skin. Since three of these areas have the most available literature to support them, they deserve more in-depth clarification and discussion.

Moist Wound Bed

During healing in a dried wound, the epidermis migrates beneath dead tissue and crust to find a living tissue bed. Occlusive dressings prevent crust formation and wound bed tissue dessication.^{4,11,18,42} Epidermal migration is presumed to be faster under occlusive dressings, because it takes place over a moist tissue layer rather than being obstructed by crust and dead tissue. Therefore, maintaining a moist wound also promotes a free and unrestricted environment for wound resurfacing.

Microflora

The desirable and undesirable effects of microflora have been studied for centuries.²⁰ Bacteria found on the surface of intact skin and in all skin wounds are usually considered undesirable. However, in the proper environment, bacteria or their metabolites stimulate epidermal migration and healing.^{6,20,26} "It is important to realize that the presence of bacteria within a wound is not indicative of infection, and diagnosis should be based on the classical clinical signs together with supportive microbiology."²¹

The critical value that defines an infectious colony is 100 000 bacteria per gram of tissue. Hutchinson²¹ has shown that colonization is present in occlusive wounds but at levels that are less than critical. In Hutchinson's study, only 2.8% of wounds dressed with occlusive dressings became infected, compared to 7.5% of all wounds dressed in some other manner.

Electrical Potential

Of recent interest is evidence supporting epidermal migration under the influence of electrical fields in wounds.^{5,22} These studies have shown that the epidermis produces a voltage similar to a battery, the inside being positive and the outside or skin surface being negative. The deeper the wound extends to the basal layer of epidermis, the lower the current produced. When wounds are produced in the skin, the resultant effect on the local electrical circuitry has been likened to that of a short circuit. As the skin wound dries, its current is switched off and the voltage gradient around the periphery of the wound is lost. Researchers suggest that occlusive dressings may increase epidermal migration because they prevent wounds from drying and losing their natural voltage gradient.^{5,22}

Occlusive dressings are now promoted for use as postoperative dressings, donor site dressings, ulcer treatments, covers for minor skin abrasions, backing for donor tissues, and dressings for blisters.^{6,21} As ATCs become more familiar with the use of occlusive dressings, these adjuncts may become more prominent in the wound management of athletes.

HEALING TIME

Research protocols that have evaluated cleansing agents typically used four treatments per day.^{12,16,29,40} Conversely, studies investigating occlusive dressings describe dressing changes at varied time intervals.^{11,13,18,28,42} Through 7 days, these occlusive dressings may only have been changed twice.^{12,28} Dressings were applied after initial cleansing and debridement for clinical cases, and applied without other treatment for laboratory animals. Researchers evaluated healing time by visual inspection. The effect of these two treatments on wound healing time can be attributed to the agent or dressing, but not to their combination.

Mellion et al²⁸ saw a 4- to 8-day healing time for abrasions using a hydrocolloid occlusive dressing. Pollack and others³⁴ treated many of their acute wounds with several types of dressings for 5 to 7 days. At the end of this time, the wounds appeared similar and resurfaced with new cells. Mean healing times, taken from reports that focused on cleansing agents in partial-thickness wounds, ranged from 7 to 15 days.^{1,12,31,41,42} It is not clear how thick the epidermis became by the end of treatment in these cases, but most of the studies identified significant resurfacing of cells within 24 hours.

COMPLICATIONS

Pain and Infection

Pain and infection are wound complications previously discussed. The useful effects of pain reduction and decreased tenderness^{10,13,20} associated with occlusive dressings have been nearly universally observed clinically. Tissue drying at the wound site with subsequent crust formation may be the cause of pain.¹³ Dermatologists conclude that this pain is probably mechanical in nature from normally mobile skin

being restricted by crust.^{10,13,20} Acute inflammatory pain is commonly present, but persistent or severe pain may be a sign of infection.

Pollack³⁴ compared clean traumatic wounds to infected ones; surgical or traumatic wounds show mild, nonpainful erythema from the wound borders up to 5 mm around—like a halo. This is usually not associated with a purulent exudate if wound cleanliness is maintained. However, infected wounds exhibit an erythema that reaches beyond 5 mm from the wound's borders. The area is tender to palpation and may or may not be associated with fever, streaking, or swollen lymph nodes.¹⁴ With pressure to the margins, pus or blood serum-like exudate is evident.

Bacteria are present in wounds and aid the wound repair process by stimulating a strong response from migrating white cells.^{26,41} Occlusive dressings appear neutral to microorganisms, especially for clean and well-perfused wounds. Increased oxygen partial pressure²³ is thought to be an important factor in re-epithelialization and important to the reduced incidence of infections.²⁶ As careful observers and without the benefit of cultures, ATCs may often be confused about the presence or absence of infection in a wound. Pollack suggests that tenderness, a wide margin of erythema, and seeping exudate on pressure are important differentiating features of infection.³⁴

Seborrheic Dermatitis

Seborrheic dermatitis is considered a common cause of widespread redness, sometimes progressing to erosions surrounding a wound.^{19,41} The condition is frequently seen in athletes with a pre-existing dermatitis and may persist well after the wound is healed. The skin appearance may be confused with infection, but is not painful and is often treated with topical corticosteroids.

Eaglstein,¹² in treating wounds with accompanying dermatitis, reported that topical treatments with an anti-inflammatory corticosteroid (0.1% triamcinolone acetonide) slowed the speed of resurfacing of a wound by about 60%. The effect is apparently related to skin atrophy from the use of corticosteroid. Hydrocortisone (1%) (another anti-inflammatory agent) did not affect resurfacing but did reduce the healing wound's collagen biosynthesis capacity. Reduced synthesis of collagen results in reduced wound strength. ATCs should be careful with the use of topical treatments for seborrheic dermatitis in the presence of a wound.

Scars

Hypertrophic scars and keloids are fibrous tumors.³² Their development is similar to the accumulation of collagen in normal wound healing during the proliferative stage, but instead of fibroplasia peaking at 3 weeks, it may be extended for months. During this proliferating period, there is an increase in the formation of vascular nodules, which then become surrounded by fibroblasts. The nodules continue to enlarge, evolving into hard, avascular, collections of collagen. Hypertrophic scars enlarge in size or bulk, whereas keloids enlarge by cellular proliferation.

Hypertrophic scarring, an uncommon complication in the healing of superficial wounds,²⁷ is a more frequent problem for full-thickness wounds.³² Most full-thickness wounds heal with a thicker central portion than outer portion. The thick central scarring usually diminishes in size after 6 months to 1 year, leaving a soft, even scar. Hypertrophic scars are most common within loose skin and over convex surfaces. Keloids can occur anywhere, but most often in areas such as the upper back, shoulders, anterior chest, and upper arm. Patients between 10 and 30 years of age are most susceptible to keloids. Treatment options for hypertrophic scars and keloids are numerous,³² including surgery, pressure therapy (frequently for months), radiation, corticosteroid injections, systemic chemotherapy, cryotherapy, and combinations of these.

Contraction of tissues occurs during the healing of deep partial-thickness wounds, and continues even after reepithelialization is complete.⁴¹ During a normal healing course, wound contraction accounts for a decrease in wound size and a smaller scar. Wound contraction is biphasic. First, there is a contraction of new tissue that peaks after reepithelialization. This is followed by partial relaxation and softening of the scar. Since contraction largely occurs in the direction of underlying muscle, annular wounds may heal with a linear scar along relaxed skin tension lines.⁴¹ Using skin mobilization treatment techniques after the initial 2 weeks of wound protection may assist a contracting skin wound to maintain fascial movement between tissue layers.

Other Complications

Other poor results from wounds are noted in the dermatologic literature as dysesthesias, unstable scars, excessive granulation, hypopigmentation, and telangiectasis.^{6,19,20,30,41} Complication rates are unknown and vary even within an individual, as do the many manifestations of healing wounds.

CONCLUSIONS

- The ATC who treats sports-induced skin wounds must observe universal precautions and must physically cleanse and dress the wound. Frequent contact with open and bleeding wounds elevates the ATC's risk of exposure to blood and body fluids. Along with observing proper precautions, the ATC needs to be knowledgeable about proper wound management. Management practices for wounds varies in the selection of both cleansing agent and dressing.
- We suggest using the following guidelines for maximum efficiency and effectiveness in the use of cleansing agents, antiseptic agents, and dressings. Use cleansing agents that stimulate epidermal migration and do not interfere with fibroplasia; 3% hydrogen peroxide (or a dilution thereof) would be effective early in wound resurfacing, and Betadine or another iodophor for cleansing the surrounding normal skin.
- In the case of blisters, remove the overlying skin, clean, and use one of the hydroactive gel dressings. However, leaving the elevated skin intact may be an effective treatment for painful, partial-thickness blisters, provided the underlying

wound is otherwise kept clean and the wound occluded. This conclusion is derived from occlusive dressing studies.^{10,15,18,21,25,28,42}

- Because the studies reviewed in this article have revealed the fragile nature of the healing wound, we advocate the use of closures and occlusive dressings until the wound has re-epithelialized. Finally, we suggest enhancing the absorption of antibiotic creams and ointments through the skin, by using these products when the altered barrier properties of young wounds are poorest, and when infection possibilities are the greatest. As long as oxygen partial pressures at the wound site are maximized by maintenance of a moist wound bed and maintenance of circulation, these procedures should be sufficient to practice wound care with confidence.
- We suspect that many athletic trainers throughout the country use the above materials and protocols when cleaning and dressing wounds. However, widely different antiseptics and dressings appear to be similarly effective on healing time when studies are conducted in the clinical setting and in animal studies. In order to develop a base of clinical information, we propose that standardized trials be established to study outcome measures on sports-induced wound healing.

ACKNOWLEDGMENT

We thank the members of the NATA who contributed their time and expertise to this project.

REFERENCES.

- Agren M, Chvapil M, Franzen L. Enhancement of re-epithelialization with topical zinc oxide in porcine partial-thickness wounds. J Surg Res. 1991;50:101–105.
- American Academy of Orthopaedic Surgeons. The skin. In: Athletic Training and Sports Medicine. 2nd ed. Park Ridge, IL: American Academy of Orthopaedic Surgeons; 1991:441–445.
- Arnheim D, Prentice W. Skin disorders. In: Arnheim D, Prentice W. Principles of Athletic Training. 8th ed. St Louis, MO: Mosby Year Book Publishers; 1993:420–435.
- 4. Bryant W. Wound healing. CIBA Clinical Symposia. 1977;29:1-36.
- Burr H, Taffel M, Harvey S. An electrometric study of the healing wound in man. *Yale J Biol Med.* 1940;13:483–485.
- Caldwell M. Topical wound therapy-an historical perspective. J Trauma. 1990;30(Suppl):S116-S122.
- Christie A. The tissue injury cycle and new advances toward its management in open wounds. *Athl Train, JNATA*. 1991;26:274–278.
- 8. Crow R. Sports-related lacerations. Phys Sportsmed. 1993;21:143-147.
- Dolan J, Holladay L. The skin and athletic considerations. In: Dolan J, Holladay L. *First Aid Management*. 4th ed. Danville, IL: The Interstate Printers & Publishers; 1954:301–310.
- Eaglstein W. Effect of occlusive dressings on wound healing. Clin Dermatol. 1984;2:107–111.
- 11. Eaglstein W. Current wound management: a symposium. *Clin Dermatol.* 1984;2:134–142.
- Eaglstein W, Mertz P, Alvarez O. Effect of topically applied agents on healing wounds. *Clin Dermatol.* 1984;2:112–115.
- Eldad A, Simon G, Kadar T, Kushnir M. Immediate dressing of the burn wound-will it change its natural history? *Burns*. 1991:17:233–238.
- Fahey T, Sadaty A, Jones W, Barber A, Smoller B, Shires T. Diabetes impairs the late inflammatory response to wound healing. J Surg Res. 1991;50:308–313.
- Fletcher S, Whitehill W, Wright K. Medicated compress for blister treatment. J Athl Train. 1993;28:81–82.

The Total Body System *PrePak's Dual Pulley*

Easy to Use. Highly Effective. Fully Guaranteed



Trunk Rotation





Scapular

Retraction

Our Dual Pulley System is perfect for strengthening the trunk, extremities or cervical areas.

Easy- and it works

How easy is our Dual Pulley System? It slips over a door. Resistance is constant– best for healing tissue.

Like it- or Your Money Back.

Your satisfaction is fully guaranteed. ONLY



FREE WITH FIRST ORDER

\$4495 ea.

Qty. discounts

available.

10 lb. Water Weight Bag and Wrist Wand.





Forearm

Pronation



2227 Faraday Ave., Dept. JAT, Carlsbad, CA 92008 SATISFACTION GUARANTEED!

- Gruber R, Vistnes L, Pardoe R. The effect of commonly used antiseptics on wound healing. *Plast Reconstr Surg.* 1975;55:472–476.
- Health care workers required to treat HIV infected patients. NATA News. June 1994:19.
- Hinman C, Maibach H, Winters G. Effect of air exposure and occlusion on experimental human skin wounds. *Nature*. 1963;200:377–378.
- Huether S, Kravitz M. Structure, function, and disorders of the integument. In: McCance K, Huether S. *Pathophysiology: The Basis for Disease in Adults and Children.* St Louis, MO: CV Mosby Company; 1990:1390– 1394.
- Hunt T. Basic principles of wound healing. J Trauma. 1990;30(Suppl): S122–S128.
- Hutchinson J, Lawrence J. Wound infection under occlusive dressings. J Hosp Infect. 1991;17:83–94.
- Jaffe L, Vanable J. Electric fields and wound healing. *Clin Dermatol*. 1984;2:34-44.
- Jensen J, Hunt T. The wound healing curve as a practical teaching device. Surg Gynecol Obstet. 1991;173:63–64.
- 24. Levine N. Friction blisters. Phys Sportsmed. Mar 1982;10:84-92.
- Levy A, Barnes R, Rijswijk L. Evaluation of a new dressing in the treatment of sports-related lesions. *Cutis.* 1987;39:161–164.
- Leyden J. Effects of bacteria on healing of superficial wounds. Clin Dermatol. 1984;2:81–85.
- Maffulli N, Pintore E, Petricciuolo F. Arthroscopy wounds: to suture or not to suture. Acta Orthop Belg. 1991;57:154–156.
- Mellion M, Fandel D, Wagner W, Kwikkel M. Hydrocolloid dressings in the treatment of turf burns and other athletic abrasions. *Athl Train, JNATA*. 1988;23:341–346.
- Monafo W, West M. Current treatment recommendations for topical burn therapy. *Burns*. 1990;40:364–373.
- Montagna W, Parakkal P. *The Structure and Function of Skin*. 3rd ed. New York: Academic Press; 1974:159.
- Mulliken J, Healey N, Glowacki J. Providone-iodine and tensile strength of wounds in rats. J Trauma. 1980;20:323–325.
- Murray J, Pollack S, Pinnell S. Keloids and hypertrophic scars. Clin Dermatol. 1984;2:121–133.
- OSHA US Department of Labor. Occupational Health and Safety Standards. 29 CFR 1910.20.
- 34. Pollack S. The wound healing process. Clin Dermatol. 1984;2:8-16.
- 35. Poole D. The DP technique for blisters. Athl Train, JNATA. 1979;14:88-
- Ramsey M. Managing friction blisters. *Phys Sportsmed*. Jan 1992;20:117– 124.
- Sulzberger M, Cortese T, Fishman L, Wiley H. Studies on blister produced by friction. J Invest Dermatol. 1966;47:456–465.
- Thorndyke A. Infections and inflammations. In: *Athletic Injuries: Prevention Diagnosis and Treatment*. 3rd ed. Philadelphia, PA: Lea & Febiger, 1950:118.
- 39. Tools of the trade. NATA News. Apr 1994:4-6.
- Welsh J. The Antibacterial and Wound Healing Characteristics of 5% Providone-iodine Cream and Betadine Ointment Compared to Neosporin Ointment. Norwalk, CT: The Purdue Frederick Co; 1987:5. Purdue Frederick Monograph.
- Winter G. Epidermal regeneration studies in the domestic pig. In: Maibach H, Rovee D, eds. *Epidermal Wound Healing*. Chicago, IL: Year Book Medical Publishers; 1972:71–112.
- Young S, Dyson M, Hickman R, Lang S, Osborn C. Comparison of the effects of semi-occlusive polyurethane dressings and hydrocolloid dressings on dermal repair: 1. Cellular changes. *J Invest Dermatol.* 1991;97: 586–592.

Theetah **ANKLE BRACE** w/Pro Heel Cup™

Revolutionary combination of Mueller's Ankle Brace technology and TULI'S[®] Pro Heel Cup[™] shock absorption. Designed for maximum comfort and stability, the Cheetah™ Ankle Brace is ideal for basketball, volleyball and other high impact sports. Helps prevent ankle injury and relieves the discomfort of shin splints, heel strike, painful ankles and knees, and Achilles tendon. Includes extra heel cup for balance. Fits either foot.

Built in shock absorbing Tulis[®] Heel Cup[™] to absorb impact energy.

Mueller

U.S. PATENTS 4,974,343 4,179,826 5,172,494 AND FOREIGN PATENTS

Nith Extra Heel Cup For Balance

(\$5.00 value)





Sizing: Acc	cording to	shoe size	- Fits eith	her foot.
Man	SM	MD	LG	XL
Women	8 - 9 9 - 10	9 - 11 10 - 12	11 - 13 12 - 14	13 - 14 14 - 15
		10 11	12 11	11 10

Heel Cup or Balanc (\$5.00 va

TULI'S[®] Cheetahs[™] are:

Easy to wear, Cheetahs

Gentle and comfortable

· A must for gymnasts or

slip on and off your feet with almost no effort

Product No. 973 White Product No. 974 Black



Sizing: A	ccording	to shoe s	size - Fits e	ither foot.
Men Women	SM 4 - 5 1/2 6 - 7 1/2	MD 6 - 7 1/2 8 - 9 1/2	LG 8- 9 1/2 10 - 11 1/2	XL 10 - 11 1/2 12 - 13

TULI'S® is a registered Trademark of International Comfort Products, Ltd. ©1995, Printed in U.S.A.

NEOPRENE ANKLE SUPPOR

w/Standard Heel Cup™

Lightweight Neoprene ankle support for comfort and stability.

Neoprene warmth and compression combines with TULI'S® shock absorbing heel cup in one lightweight unit. Perfect solution for tired, aching feet, legs and back. Can be worn inside shoe or barefoot (for gymnasts). Includes extra heel cup for balance. Fits either foot

Product No. 972 Black





washable

on your feet



MUELLER SPORTS MEDICINE, INC., One Quench Drive, Prairie du Sac, WI 53578 USA 1-800-356-9522 • 608-643-8530 • FAX 608-643-2568 • ORDER FAX 1-800-852-4334



Who says your plinth has to look like you made it in wood shop?

INTRODUCING THE PLYNTH™

- All-steel frame
- High density foam cushion
- Seamless Naugahyde[®] upholstery available in designer colors
- 30" height
- Available in a variety of widths and lengths

Wellness By Design®

CHATTANOOGA GROUP, INC. 4717 Adams Road • P.O. Box 489 Hixson, TN 37343-0489

1-800-592-7329 ©1995 Chattanooga Group, Inc.

Wound Management: The Occlusive Dressing

Scot B. Rheinecker, MS, ATC, PA-S

ABSTRACT: Superficial wounds resulting from athletic injury are common in sports medicine. Although such wounds can be quite painful, they are usually merely inconvenient to the athlete. If improperly managed, however, superficial wounds may heal slowly and cause unnecessary scar tissue proliferation at the wound site. Scar formation causes the wound to break open frequently and puts the athlete at risk of cross-contamination by pathogenic organisms. New advances in the

thetic trainers are committed to returning athletes to competition as quickly and as safely as possible. Wounds resulting from athletic competition are very common⁷ and may hinder the athlete in his or her sport.^{7,15} Infection, pain, and limited range of motion are some possible consequences of wounds.¹⁵ Treatment methods for these wounds are almost as varied as the wounds themselves.⁷ For many years, it was thought that wounds should be exposed to the air in order to "breathe" and scab over.^{7,10,21} Recent advances in wound care technology, however, have shown that this may not be the most prudent course of action to ensure the safest and fastest mode of healing.^{1,3,5–7,9,11,15–20,22}

The role of occlusion or retention of moisture within the wound bed has led to the use of occlusive dressings in the treatment of many types of wounds.^{4-6,15-20} Research has shown that wounds treated by occlusion heal more rapid-ly,^{1,5,6,9,10,15,16,19,21,22} are less painful,^{15,18} and are less prone to infection and cross-contamination than wounds not treated or treated by other methods.^{8,9,11-18,20} In this paper, I give a detailed overview of the most common types of occlusive dressings so that the athletic trainer can make an informed choice when selecting a dressing for wound management.

OCCLUSIVE DRESSINGS

Occlusive dressings affect wounds by trapping moisture next to the wound bed. This moisture is thought to protect the wound surface by preventing desiccation and additional trauma. Desiccation and trauma impede the migration of new epidermal cells across the wound surface.¹¹ Three main types of occlusive dressings are useful in sports medicine: 1) semipermeable films,^{8,16,20} 2) hydrogels,^{8,16,20} and 3) hydrocolloids.^{8,16,20} Examples, functions, and features of each follow.

Films

Films are semipermeable dressings composed of polyurethane or polyethylene with an adhesive coating on one side.²⁰ Examples

Scot B. Rheinecker is currently a first-year student in the Physician Assistant Program at Emory University, Atlanta, GA 30322.

science of wound management strongly favor the use of occlusive dressings to increase patient comfort, increase patient compliance, decrease the risk of infection, and decrease overall healing time. Occlusion has clearly been proven to aid in the healing of superficial wounds and should be considered as a treatment alternative for wounds in the sports medicine setting. In this paper, I discuss three of the most widely used types of occlusive dressings: 1) films, 2) hydrogels, and 3) hydrocolloids.

of frequently advertised films are: Bioclusive (Johnson & Johnson Medical, Inc, Arlington, TX), Tegaderm (3 M Medical-Surgical Div, St Paul, MN), and Opsite (Smith & Nephew, Carlsbad, CA). Films allow inspection of the wound because they are transparent. They possess elastic properties that account not only for their conformity, but also for their resistance to shear and tear.²⁰ Films are permeable to water vapor, oxygen, and other gases, but are impermeable to water and bacteria.^{8,20}

Since films maintain a moist wound environment, they function as occlusive dressings and usually are indicated in the treatment of superficial abrasions, blisters, cuts, and minor burns.¹⁶ The dressings often reduce pain by keeping the wound moist, and may stay in place for several days. All films are produced as sterile dressings, and may be used alone or in conjunction with topical solutions or ointments. The dressings are waterproof, conform to body contours, and do not require frequent changes; therefore, compliance is generally good.

One drawback to semipermeable dressings is that they are nonabsorbent; therefore, they are not advised for heavily draining wounds. Channels often form in the dressing, allowing wound fluid to leak out. Leaking compromises the dressing's barrier capabilities.^{8,16,20} Caution is also advised on removal of films, because the adhesive may strip away newly formed epithelium and damage the healing wound.^{8,16}

Hydrogels

Hydrogels are transparent polyethylene membranes whose composition is more than 90% water.^{8,16} Examples commonly seen are: Spenco 2nd Skin (Spenco Medical Products, Waco, TX) and Vigilon (CR Bard, Inc/Bard Patient Care, Murray Hill, NJ). These dressings maintain a wound environment similar to that of films, but, in contrast to films, hydrogels are superabsorbent. Therefore, they are able to handle excess exudate from wounds without leakage. Hydrogels also have an immediate cooling effect on the wound, which may be augmented by refrigeration before use.^{8,16,20} Like films, hydrogels are indicated in the treatment of blisters and minor lacerations, but may also be used for more severe wounds such as deep abrasions and second-degree burns because of the dressing's cooling ability and exudate absorbency.¹⁶

Since hydrogels are nonadhesive, they must be secured by an alternate method, such as bandaging or taping. This may hinder bathing if the bandage or tape is not waterproof. Furthermore, hydrogels cannot be left in place for more than 1 or 2 days, because they have a tendency to dry out, eliminating their effectiveness. It should also be noted that, although no bacterial penetration of these dressings has been reported, they are capable of supporting the growth of microorganisms, especially in the presence of absorbed wound exudate.²⁰ Serious wounds, therefore, should be inspected regularly for clinical signs of infection.

Hydrocolloids

Hydrocolloids are composed of hydrophilic particles, such as gelatin and pectin, connected together with a hydrophobic adhesive matrix, and are covered by an outer film or foam layer.^{13,16} They are the most widely known absorbent polymers. Some examples are DuoDERM (ConvaTec Inc, Princeton, NJ), Comfeel (Coloplast Inc, Espergaerde, Denmark), and Tegasorb (3M Medical-Surgical Div, St. Paul, MN). Hydrocolloids are opaque and impermeable to bacteria and outside contaminants.¹³ Also, they contain a different wound environment than that of films or hydrogels.

When hydrocolloids are applied to a wound, any exudate in the wound contact area is absorbed to form a swollen gel, which fills the wound and provides a controlled absorption gradient to the rest of the dressing.^{13,20} This means that the dressing acts as a "sponge" to absorb wound exudate. The gel conforms to the wound contours and remains in place when the dressing is removed.^{8,13,16,20} This gel can be washed away with sterile saline with no damage to the wound.^{8,16,20} The effects of the monomers released into the wound by degradation of the dressing have yet to be fully understood, but they seem to foster autolytic debridement of the wound.^{16,20} This means that the dressing prompts the body to "cleanse" itself by phagocytosing debris in the wound. The autolytic debridement normally results in an initial enlargement of the wound caused by the removal of necrotic tissue,⁸ not by an exacerbation of the wound itself.

Hydrocolloids are waterproof and backed by a strong hypoallergenic adhesive; therefore, athletes are able to bathe and leave the dressings in place for several days. Infrequent changes and comfort allows for high compliance in their use.^{8,13,15} It should be remembered, however, that if the dressing seal is breached, a dressing change is warranted to avoid infection. Hydrocolloid dressings may leave an odorous residue of adhesive mixed with wound exudate upon removal of the dressing.¹⁶ This is known as the "gel and smell" phenomenon,⁸ and should not be considered indicative of infection, unless other clinical signs such as redness, heat, and swelling are also present. Additionally, since hydrocolloids are designed to remain in place for several days, removal may be difficult if dressing changes are made at shorter intervals.

RATIONALE BEHIND OCCLUSIVE DRESSINGS

Traditional dressings such as gauze and telfa pads promote desiccation of the wound surface and adhere to it as well.¹⁸ When removed, the dressing strips away newly formed epithe-lium, causing bleeding and prolongation of the healing process.

Since the wound is dry and cracked, movement is often painful and inhibited. A number of authors have shown that occlusive dressings prevent desiccation and eschar formation by trapping moisture next to the wound bed.^{3,4,6,10,15,18,20} This allows the wound to remain soft and pliable, preventing re-injury during athletic competition.

Increased Comfort of Wound

In his 1987 study of artificial turf abrasions among football players, Levy¹⁵ found that the use of a hydrocolloid dressing greatly enhanced athlete compliance and comfort when treating abrasions. The wounds were free from reopening, remained moist and pliable, and allowed normal movement in practice and competition. In separate studies, Turner²⁰ and Provan¹⁸ reported similar findings regarding wound comfort. This would seem to indicate that when the wound is kept moist, it not only resists reinjury, but also allows the athlete greater freedom of movement and decreased pain.

Increased Compliance of Athletes

Wound care is not often a priority to the athlete if it requires frequent and painful dressing changes. Occlusive dressings have the ability to stay in place for days at a time without changing.^{16,18,20} Furthermore, dressings such as films allow inspection of the wound without removing the dressing.^{16,18,20} Hydrocolloid and hydrogel dressings are nonadherent to the wound bed; therefore, they do not strip away newly formed epithelium and are relatively painless to change.^{15,16,18,20}

Semipermeable films and hydrocolloids have the benefit of being waterproof and relatively unobtrusive; therefore, they do not force the athlete to disrupt his or her daily schedule. The athlete is able to practice, compete, and even bathe with minimal risk of the dressing coming loose or becoming compromised in its function.^{13,15,18,20}

Decreased Risk of Infection

It is generally assumed that occlusive dressings increase the risk for infection by completely sealing the wound and allowing the bacterial count to increase.² Early research^{10,21} seemed to confirm this assumption; however, these studies were carried out with a nonpermeable dressing of polyethylene film, which has been proven to increase the resident skin flora.^{8,12} In contrast, Lawrence¹⁴ reported that occlusion with hydrocolloid and polyurethane film dressings did not lead to changes in the resident skin flora. Additionally, a better understanding of the role of occlusion has led to the development of more advanced occlusive dressings that are either water vapor permeable and/or capable of absorbing exudate.¹² These features not only enhance the dressings' moisture-retaining capabilities, but also increase their protectiveness.

Many occlusive dressings are far superior to conventional dressings in their barrier capabilities.^{12,20} Hydrocolloid dressings have been found to be virtually "bacteria-proof" with anticipated everyday use.¹³ Films have also been proven to be impermeable to bacteria, making them highly effective in preventing infection.²⁰ It must be stressed, however, that, while



To order, call 1-800-638-0672 • Refer to order #T5214S/S5B162 • FAX:1-800-447-8438

* while supplies last ACSMAD 4 95 T5214S S5B162 Williams & Wilkins A WAVERLY COMPANY



occlusive dressings provide a formidable barrier to infection, no dressing is without limitations. Proper cleansing, debridement, and cessation of hemorrhage before any dressing application is still the first and most important line of defense in preventing infection.

Decreased Healing Time

A number of authors have investigated the role of occlusive dressings in the healing of wounds. Dyson,⁵ Young,²² and Harris⁹ reported increased macrophage and fibroblast infiltration of wounds under occlusion. These cells are responsible for stimulating the synthesis of collagen, which binds the wound together and increases its tensile strength. Similarly, Alvarez et al¹ found that the process of collagen synthesis and re-epithelialization increased with occluded wounds when compared to air-exposed wounds in the domestic pig. Other experimental studies have reported similar findings,^{10,19,21} indicating that occlusion favors the increased population of polymorphonucleocytes, macrophages, fibroblasts, and endothelial cells. Occlusion appears to facilitate the inflammatory response and prompts a rapid progression from the proliferative to the maturation phase of healing.

An additional advantage of occlusive dressings, specifically hydrocolloids, over conventional dressings, is that they do not retard healing by stripping away newly formed epithelium during dressing changes. Hydrocolloid dressings form a gel with the wound bed that remains intact when the dressing is changed. Therefore, the epithelial layer is not disrupted by dressing changes and may regenerate more rapidly.

CONCLUSION

Occlusive dressings protect the wound from both pathogenic invasion and further trauma. They act as barriers and prevent the entry of outside pathogens that might infect the wound and retard healing.^{4,8,12,13,16–18,20} Since they conform to the body's contours, they are more likely to remain in place and offer protection from further trauma as well. They move as the body moves, making them less susceptible to shear and tear during the rigorous daily activities of an athlete.^{15,16,18,20}

Occlusive dressings possess many characteristics that make them desirable in sports medicine. They decrease the pain of wounds, reduce the risk of infection, and allow the wound to heal rapidly. Furthermore, due to their waterproof characteristics, they rank high in athlete compliance. Currently, research on the use of these dressings among athletic trainers is scarce. Research to determine the most effective uses of occlusive dressings is warranted. Areas not addressed in this paper, but worth investigating, are the cost effectiveness of occlusive dressings in the sports medicine setting, potential difficulties with the use of occlusive dressings among various sports, controlled comparisons of conventional vs occlusive dressings on wounds encountered within specific sports, and comparisons of infection rates with conventional vs occlusive dressings among competing athletes.

Athletic trainers are committed to providing the highest quality of health care possible to their athletes. Currently, there are many dressings available to help maintain that standard of health care. It is the athletic trainer's responsibility to critically

investigate available choices to make informed decisions when treating athletes under his/her care.

REFERENCES

- 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.
- Bennett RG. The debatable benefit of occlusive dressings for wounds. Dermatol Surg Oncol. 1982;8:166–167.
- Berardesca E, Vignoli GP, Fideli D, Maibach H. Effect of occlusive dressings on the stratum corneum water holding capacity. *Am J Med Sci*. 1992;304:25–28.
- 4. David JA. Wound Management: A Comprehensive Guide to Dressing and Healing. Springhouse, PA: Springhouse Corp; 1988:144–147.
- Dyson M, Young S, Pendle L, Webster D, Lang S. Comparison of the effects of moist and dry conditions on dermal repair. *J Invest Dermatol.* 1988;91:434-439.
- Eaglstein WH. The effect of occlusive dressings on collagen synthesis and re-epithelialization in surgical wounds. In: Ryan TJ, ed. An Environment for Healing: the Role of Occlusion. Proceedings of the First International Symposium on Occlusion. London: Royal Society of Medicine; 1985:31–38.
- Foster DT. Wound management for the physically active. Presented at the Annual Meeting and Clinical Symposium of the National Athletic Trainers' Association; June 10, 1993; Kansas City, MO.
- Gilchrist B, Hutchinson J. Does occlusion lead to infection? Nurs Times. 1990:86:70–71.
- Harris B, Cai J, Falanga V, Mertz P, Chin Y, Eaglstein W. The effects of occlusive dressings on the recruitment of mononuclear cells by endothelial binding into acute wounds. *J Dermatol Surg Oncol.* 1992;18:279–283.
- Hinman CD, Maibach H. Effect of air exposure and occlusion on experimental human skin wounds. *Nature*, 1963;200:377–378.
- Holland KT, Davis W, Ingham E. A comparison of the in vitro antibacterial and complement activating effect of Opsite[®] and Tegaderm[®] dressings. J Hosp Infect. 1984:5:523–528.
- Hutchinson JJ, Lawrence JC. Wound infection under occlusive dressings. J Hosp Infect. 1991;17:83–94.
- Lawrence JC. The physical properties of a new hydrocolloid dressing. In: Ryan TJ, ed. An Environment for Healing: the Role of Occlusion. Proceedings of the First International Symposium on Occlusion. London: Royal Society of Medicine; 1985:69–76.
- Lawrence JC, Lilly HA. Bacteriological properties of a new hydrocolloid dressing on intact skin of normal volunteers. In: Ryan TJ, ed. An Environment for Healing: the Role of Occlusion. Proceedings of the First International Symposium on Occlusion. London: Royal Society of Medicine; 1985:51–54.
- Levy AM, Barnes R, Rijswijk L. Evaluation of a new dressing in the treatment of sports-related skin lesions. *Cutis.* 1987;39:161–164.
- Mertz PM. Intervention: dressing effects on wound healing. In: Eaglstein WH, ed. Wound Care Manual: New Directions in Wound Healing. Princeton, NJ: Squibb & Sons, Inc; 1990:83–96.
- Mertz PM, Marshall DA, Eaglstein WH. Occlusive wound dressings to prevent bacterial invasion and wound infection. J Am Acad Dermatol. 1985;12:662–668.
- Provan A, Phillips TJ. An overview of moist wound dressings: the under cover story. *Dermatol Nurs*. 1991;3:393–396.
- Rovee DT. Effect of local wound environment on epidermal healing. In: Maibach HL, Rovee DT, eds. *Epidermal Wound Healing*. Chicago, IL: Year Book Medical Publishers Inc; 1972:159–181.
- Turner TD. Semi-occlusive and occlusive dressings. In: Ryan TJ, ed. An Environment for Healing: the Role of Occlusion. Proceedings of the First International Symposium on Occlusion. London: Royal Society of Medicine; 1985:5–14.
- Winter GD. Formation of the scab and the rate of epithelialization of superficial wounds in the skin of the young domestic pig. *Nature*. 1963;200:293–294.
- Young S, Dyson M, Hickman R, Lang S, Osborn C. Comparison of the effects of semi-occlusive polyurethane dressings and hydrocolloid dressings on dermal repair: 1. cellular changes. *J Invest Dermatol.* 1991;97:586–592.



In short, they're cooler.



COMPRESSION SHORTS

With breathable Intera® in 14 team colors. Contact your local dealer or call 1-800-237-8254.



BRACE / international



CONTROLS RANGE OF MOTION MINIMIZES EXTERNAL ROTATION

PAT# 4,735,198

SAWA SHOULDER BRACE: THE PROVEN ONE

The **SAWA SHOULDER BRACE** is a major advancement in the design of shoulder girdle support. The snug-fitting, lightweight material (under 2 pounds) allows for comfort with movement. Its strap design system allows many options for maximum stability where needed, while giving you the range of motion also needed to help protect the glenohumeral joint from subluxations and dislocations.

The **SAWA BRACE** also has the added ability to support the acromio-clavicular joint by providing compression to the distal end of the clavicle.







BAR 1 GROIN/THIGH

The ideal brace for:

- Adductor strains

 a. Gracilis
 b. Sartorius
- 2. Quadriceps/rectus femoris tear
- 3. Support hamstring strain
- 4. Hip flexor strain
- **5.** Thigh contusions—Provides gentle support to assist muscle action when damaged from deep bruising.

The **BAR 1** — co-developed by Dr. Thomas Sawa and Ray Barile, A.T.C., head hockey trainer at Cornell University — takes a revolutionary approach to the problematic treatment of groin/ thigh injuries. The **BAR 1** supports contractile tissue by mechanically supporting the normal musculature while the damaged soft tissue is healing.

Call TOLL FREE 1-800-545-1161 for more information.

CALL TOLL FREE

1-800-545-1161

WE HIGHLY RECOMMEND ITS USE FOR ALL SPORTS

P.O. Box 19752 (404) 351-3809 ATLANTA, GA. 30325-07532 /

SEE US AT NATA BOOTH 927

Arterial Supply to the Human Anterior Cruciate Ligament

Brian J. Toy, PhD, ATC; Richard A. Yeasting, PhD; Dennis E. Morse, PhD; Patricia McCann, MS

ABSTRACT: The arterial supply to the anterior cruciate ligament (ACL) was prepared for study by injecting a fresh cadaver knee with an epoxy lead-oxide solution and subsequently immersing it in 10% formalin for a 2-week period. The vasculature of the ACL was exposed through dissection for examination. A second specimen was prepared similarly and was evaluated by a CAT scan. ACL vascularization arises from the middle genicular artery and vessels of the infrapatella fat pad and adjacent synovium. The artery gives rise to periligamentous vessels which form a web-like network within the synovial membrane. These periligamentous vessels give rise to pene-

Scientific literature concerning the functional anatomy, recognition, treatment, and rehabilitation of the injured anterior cruciate ligament (ACL) of the knee is plentiful ^{2,5,7,8,14,16,18–21,23}; however, information regarding this ligament's vascularization is lacking. Dunlap et al⁸ claim that the vascular pattern of the ACL is not well understood and state that few studies have attempted to quantify the vascular perfusion of the ACL. The vascular anatomy described in humans has been shown to be comparable to that in canines ^{5,20,22}; thus, much of the original research to date concerning the blood supply to this ligament has been performed on dogs.^{1,5,8,15} Few studies of ACL vascularization have been performed on human cadaver specimens.^{14,22}

The ACL has been described as a relatively hypovascular structure.⁸ However, some researchers have claimed that there are adequate intraligamentous blood vessels throughout the entire ligament for healing to occur following injury.¹⁴ When the ACL is injured, its vascular supply is affected and the viability of the ligament is often in question.^{20,21} Disruption of the ligament's blood supply has been described as the cause of the profuse effusion and hemarthrosis experienced 24 hours after initial injury.⁹ DeHaven⁶ reported that of 113 acute knee injuries associated with hemarthrosis incurred within 4 hours of trauma, 81 (72%) were caused by injury to the ACL.

Gaining an understanding of the source of effusion may aid the athletic trainer in evaluating, treating, and rehabilitating injuries to the ACL. In addition, the athletic trainer may be able to use this information to enhance an athlete's adherence to an injured ACL's treatment and subsequent rehabilitation protrating branches which transversely cross the ACL and anastomose with a network of longitudinally oriented endoligamentous vessels. Terminal branches of the inferior medial and lateral genicular arteries supply the distal portion of the ACL directly. The extremities of the ACL seem to be better vascularized than the middle part, and the proximal portion seems to have a greater vascular density than the distal portion. The arteries at the ligamentous-osseous junctions of the ACL do not significantly contribute to the ligament's vascularity. Ramifications concerning the ACL's blood supply as it relates to athletic training is also discussed.

gram.¹¹ A proper understanding of the arterial supply of the ACL will allow the athletic trainer to better respond to an athlete's questions about the large amounts of hemarthrosis the athlete will experience in an ACL injury.

METHODS

In order to display the arterial pattern of the human ACL, the arteries of two fresh cadaver knees were injected with an epoxy solution containing lead oxide. The lead oxide was added to the epoxy to highlight the specimen's vascular network and to add density for Computer Axial Tomography (CAT) scan analysis. The epoxy solution was allowed to dry and harden. Then, the specimens were immersed in a 10% formalin solution for 2 weeks. Subsequently, all soft tissue superficial to the ACL of one specimen was discarded and the vasculature of the ligament, which was now easily identified by the bright orange coloration, was examined through fine dissection. After being removed from the formalin solution, the unaltered second specimen was subjected to a CAT scan and the ligament's vascularity was studied. It should be noted that since only two specimens were used in this study, the reported results may not be indicative of the arterial patterns exhibited by the average ACL. As a result, the conclusions drawn may not be representative of the general population.

RESULTS

Anterior cruciate ligament vascularization arose primarily from the middle genicular artery and the adjacent synovium. After branching from the popliteal artery, the middle genicular artery coursed along the dorsal aspect of the ACL while giving rise to ligamentous branches to the ligament (Fig 1). These ligamentous branches seemed to form a network of vessels, which gave rise to connecting branches that transversely crossed the ACL and anastomosed with longitudinally oriented intraligamentous vessels (Fig 2). The transverse branches

Brian J. Toy is an assistant professor and Director of Athletic Training Curriculum in the Department of Health and Leisure at Southeast Missouri State University in Cape Girardeau, Missouri 63701. Richard A. Yeasting and Dennis E. Morse are professors in the Department of Anatomy at Medical College of Ohio in Toledo, Ohio. Patricia McCann is a senior research assistant in the Department of Anatomy at Medical College of Ohio.



Fig 1. Cadaver specimen-posterior view showing: 1) The middle genicular artery (MG) arising from the popliteal artery (P) and providing a ligamentous branch (LB) to the ACL. 2) The tibial descending branch (TDB) of the MG coursing along the dorsal aspect of the ACL. 3) The TDB bifurcating into right (RTC) and left (LTC) tibial condylar arteries.

connected to the intraligamentous vessels primarily at the ligament's proximal and distal ends. The arteries entering the proximal part of the ligament were larger than the arteries entering the distal part.

In addition to supplying the ACL, the middle genicular artery was responsible for providing blood supply to the distal femoral epiphysis and proximal tibial epiphysis. The middle genicular artery ultimately bifurcated into right and left arteries at a point just proximal to the tibial spine. These arteries were then distributed to the right and left tibial condyles, respectively (Fig 1).

Additional blood supply to the ACL came from the inferior medial and lateral genicular arteries. These arteries branched from the posterior surface of the popliteal artery before traversing anteriorly. The inferior medial genicular artery passed below the medial condyle of the tibia and deep to the tibial collateral ligament, while the inferior lateral genicular artery passed proximal to the fibular head and deep to the fibula collateral ligament. The inferior lateral genicular artery ran at the level of the joint line and was found to provide vascularization to the periphery of the lateral meniscus as it



Fig 2. Transverse section CAT scan view through the distal femoral epiphysis showing longitudinal orientated intraligamentous (IL) arterial vessels located within the ACL. These vessels are also referred to as "endoligamentous" vessels.

passed (Fig 3). These arteries eventually became embedded and anastomosed within the infrapatella fat pad located on the posterior surface of the patella ligament (Figs 3 and 4). Terminal branches of the inferior genicular arteries supplied the distal portion of the ACL directly (Fig 3).

DISCUSSION

Our findings substantiate the work of others who reported the vascularization of the ACL to be predominantly of soft tissue origin.^{1,5,22}

Middle Genicular Artery Supplying the Anterior Cruciate Ligament

The majority of the ligament's blood supply originates from branches of the middle genicular artery and the adjacent synovium.^{1,3–5,14,22} The middle genicular artery penetrates the posterior joint capsule at the level of the intercondyloid notch,²² and courses within a synovial membrane which surrounds the ligament.^{1,5,22} This synovial membrane originates at the posterior inlet of the intercondylar notch of the femur and extends around the proximal attachment of the ligament.¹ Scapinelli²² referred to the portion of the middle



Fig 3. Cadaver specimen-anterior view showing: a) The inferior lateral genicular artery (ILG) running at the level of the joint line while providing arterial supply to the periphery of the lateral meniscus. b) The inferior medial genicular (IMG) and the ILG arteries becoming embedded and anastomosing within the infrapatella fat pad. c) The terminal branches of the ILG and IMG arteries supplying the distal portion of the ACL directly.

genicular artery coursing along the dorsal aspect of the ACL as the "tibial descending branch" of the middle genicular artery (Fig 1).

The ligamentous branches arising from the middle genicular artery that give rise to transversely orientated connecting vessels have been described as a web-like network of periligamentous vessels^{1,4,5} within the synovial membrane, ^{1,4,5} which ensheaths the entire length of the ligament.^{1,4} Our findings related to these periligamentous vessels agrees with the work of others.^{1,4,5,14,15} Many have termed these intraligamentous vessels "endoligamentous" vessels (Fig 2).^{1,4,15} Kennedy et al¹⁴ described them as tortuous in nature, thus enabling them to withstand the demands of the ligament's complex movements.

The central portion of the ACL is less vascular than its proximal and distal portions.^{1,5} Histological sectioning has demonstrated that the number and size of vessels in the central portion of the ligament are less than the ligament's proximal and distal portions.¹ We agree with the assertion that the transverse branches arising from the periligamentous vessels connect to the endoligamentous vessels primarily at the ligament's proximal and distal ends. The extremities of the ACL seem to be better vascularized than the middle part. Our observation that the arteries entering the proximal part of the ligament were larger than the arteries entering the distal part agrees with the work of Alm et al.¹ We agree that the proximal portion of the ACL has a greater vascular density than the distal portion.

Middle Genicular Artery Supplying the Anterior Cruciate Ligament's Ligamentous-Osseous Junctions

In addition to supplying the ACL, the middle genicular artery is responsible for the majority of the blood supply to the



Fig 4. Oblique section CAT scan view through distal femur/ proximal tibia and patella showing the inferior lateral genicular (ILG) and inferior medial genicular (IMG) arteries embedded and anastomosing within the infrapatella fat pad.

distal femoral epiphysis and proximal tibial epiphysis.²² However, arteries at the ligamentous-osseous junctions of the ACL do not significantly contribute to the ligament's vascularity.^{5,15,22} This avascularity is a general feature of all ligamentous attachments and corresponds histologically to a layer of fibro cartilage.²² The arteries that bifurcate at the distal end of the tibial descending branch of the middle genicular artery have been referred to as right and left "tibial condylar" arteries (Fig 1).²²

Medial and Lateral Inferior Genicular Arteries Supplying the Anterior Cruciate Ligament

The course of both inferior medial and lateral genicular arteries in our specimens mimicked the findings of others,^{3–5,8} that additional blood supply to the ACL comes from the infrapatella fat pad via the terminal branches of these arteries. The inferior lateral genicular artery may aid in the formation of the membrane's weblike network by connecting with periligamentous vessels.⁴ Our observation that the lateral inferior genicular artery provides vascularization to the periphery of the lateral meniscus supports the work of Scapinelli.²²

Implications for Athletic Training

Educating athletes about their particular injury is an important initial step in the rehabilitation process.¹² Thus, athletic trainers need to demonstrate their competence to help reassure the injured athlete that they have the knowledge to deal with his/her particular condition.¹² Although this will not guarantee that the athlete will adhere better to their treatment program,¹³ athletic trainers feel that explaining the injury to the athlete plays an important role in getting the athlete to comply with the rehabilitation process.¹¹ Too little information provided to some individuals may cause limited treatment adherence; therefore, these athletes need to understand the nature and the extent of their injuries more than others.¹⁷ Although athletes seem to place more emphasis on knowledge of the rehabilitation regime than on the details of the injury, not all athletes will be uninterested in the details of their injuries.¹⁰

The athletic trainer should also appreciate how injury to certain structures affects the arterial supply to the ACL. Intact synovial tissue and an intact infrapatella fat pad contribute to the vascularity of the ACL. Thus, injury to these structures greatly diminishes the ACL vascularization in the canine model.^{5,15} Dissection of the ligament's surrounding synovium almost completely disrupts blood flow to the ligament. Division of the infrapatella fat pad causes a twofold decrease in perfusion to the ACL.8 Hemorrhagic effusion as a result of injury to the ACL almost always involves lesions to the branches of the middle genicular artery.²² Therefore, disruption of these soft tissues accounts for the profuse effusion and hemarthrosis experienced following initial injury to this ligament. Scapinelli²² claimed the avascular nature of the insertions of the ACL ligament to its bony attachments explains the slowness of the repair process after traumatic detachments at this level.

During the rehabilitation of a nonsurgical tear of the ACL, the athletic trainer should realize that anterior stresses on the ligament's arterial supply will diminish the blood flow to the ligament in canine specimens to one-fifth of baseline value. Blood flow returns to normal, however, after cessation of the stress.8 Return of perfusion is important to the maintenance of the ACL over prolonged periods.² Dunlap et al⁸ have suggested that the ligament may experience periods of increased blood flow followed by decreased blood flow during exercise. This event may play a role in those cases when the ACL becomes injured during excessive anterior displacement of the tibia on the femur. Although the benefits of early passive motion of a joint following the trauma of surgery are reported in the literature,^{6,18,23} the use of continuous passive motion on the knee joint following ACL surgery does not increase nutrient uptake.24

REFERENCES

 Alm A, Stromberg B. Vascular anatomy of the patella and cruciate ligaments: a microangiographic and histologic investigation in the dog. *Acta Chir Scand Suppl.* 1974;445:25–35.

- Arnoczky SP. The vascularity of the anterior cruciate ligament and associate structures. In: Jackson DW, Drez D, eds. *The Anterior Cruciate Deficient Knee: New Concepts in Ligament Repair.* St. Louis, MO: CV Mosby Co; 1987:27–54.
- Arnoczky SP. Blood supply to the anterior cruciate ligament and supporting structures. Orthop Clin North Am. 1985;16:15–28.
- 4. Arnoczky SP. Anatomy of the anterior cruciate ligament. *Clin Orthop*. 1983;172:19–25.
- Arnoczky SP, Rubin RM, Marshall JL. Microvascular of the cruciate ligaments and its response to injury: an experimental study in dogs. *J Bone Joint Surg* [*Am*]. 1979;61A:1221–1229.
- DeHaven KE. Diagnosis of acute knee injuries with hemarthrosis. Am J Sports Med. 1980;8:9–14.
- Draper V, Ladd C. Subjective evaluation of function following moderately accelerated rehabilitation of anterior cruciate ligament reconstructed knees. J Athl Train. 1993;28:38–41.
- Dunlap J, McCarthy JA, Joyce ME, Ogata K, Shively RA. Quantification of the perfusion of the anterior cruciate ligament and the effects of stress and injury to supporting structures. *Am J Sports Med.* 1989;17:808-810.
- 9. Feagin JA, Abbot HG, Rokous JR. The isolated tear of the anterior cruciate ligament. J Bone Joint Surg [Am]. 1972;54A:1340-1341.
- Fisher AC, Hoisington LL. Injured athletes' attitudes and judgements toward rehabilitation adherence. J Athl Train. 1993;28:48–54.
- Fisher AC, Mullins SA, Frye PA. Athletic trainers' attitudes and judgements of injured athletes' rehabilitation adherence. *J Athl Train.* 1993;28: 43–47.
- Fisher AC, Scriber KC, Matheny ML, Alderman MH, Bitting LA. Enhancing athletic injury rehabilitation adherence. *J Athl Train*. 1993;28: 312–318.
- 13. Haynes RB. Compliance with health advise: an overview with special reference to exercise programs. *J Cardiac Rehab.* 1984;4:120–123.
- Kennedy JC, Weinberg HW, Wilson AS. The anatomy and function of the anterior cruciate ligament. J Bone Joint Surg [Am]. 1974;56A:223–235.
- Marshall JL, Arnoczky SP, Rubin RM, Wickiewicz TL. Microvasculature of the cruciate ligaments. *Phys Sportsmed*. Mar 1979;7:87–91.
- Marshall JL, Rubin RM. Knee ligament injuries-a diagnostic and therapeutic approach. Orthop Clin North Am. 1977;8:641–668.
- Morisky DE. Nonadherence to medical recommendations for hypertensive patients: problems and potential solutions. *J Compl Health Care*. 1986;1: 5–20.
- Noyes F, Mangine R. Early knee motion after open and arthroscopic anterior cruciate ligament reconstruction. *Am J Sports Med.* 1987;15:149– 160.
- O'Donoghue DH. A method for replacement of the anterior cruciate ligament of the knee. Report of twenty cases. J Bone Joint Surg [Am]. 1963;45A:905–924.
- O'Donoghue DH, Rockwood CA Jr, Frank GR, Jack SC, Kenyon R. Repair of the anterior cruciate ligament in dogs. *J Bone Joint Surg [Am]*. 1966;48A:503–519.
- 21. Reynolds FC. Injuries to the knee. Clin Orthop. 1967;50:137-146.
- Scapinelli R. Studies on the vasculature of the human knee joint. Acta Anat (Basel). 1968;70:305–331.
- 23. Shelbourne DK, Nitz P. Accelerated rehabilitation after anterior cruciate ligament reconstruction. *Am J Sports Med.* 1990;18:292–299.
- Skyhar MJ, Danzig LA, Hargens AR, Akeson WH. Nutrition of the anterior cruciate ligament: effects of continuous passive motion. *Am J Sports Med.* 1985;13:415–418.



With Jocal Compression

he primary objective of acute ankle sprain treatment is edema control. The most effective means for both prevention and removal of lateral ankle edema is the application of *focal compression* to the *soft tissues on the periphery* of the fibular malleolus.

FOCAL COMPRESSION



The **MULTI-PHASE Orthosis** focal compression "U" plate/pad "fills" the anterolateral and posterolateral ankle gutters to provide more effective compression on the **periphery** of the fibular malleolus. The focal compression pad and drainage channel facilitates translocation of edema to the lymphatic system soft tissue of the leg.

FOCAL COMPRESSION PLATE/PAD



LIMITED FUNCTION

INJURY STABILIZATION WITH

The **MULTI-PHASE** Orthosis locks in a limited motion position to prevent plantarflexion (but allows dorsiflexion) to decrease tension within the damaged ATFL and to limit edema translocation to the forefoot. It easily converts to a full function (plantarflexion) for postacute rehabilitation.

LOCKED FOOTPLATE PREVENTS PLANTARFLEXION AND ALLOWS DORSIFLEXION

FULL FUNCTION WITH INVERSION CONTROL



The MULTI-PHASE

Orthosis is designed to provide a high degree of inversion control. It is easily converted from a *limited function* neutral-dorsiflexed position to a post-acute *full function* brace that allows full range of plantarflexion and dorsiflexion, while continuing to provide focal compression and optimum inversion control.

SCIENTIFIC, INC.

To place an order or for more information, call 1 800 448-OMNI (6664) FAX: 510 682-1518 179 Mason Circle, Concord, CA 94520-1213

© Copyright 1994, OMNI Scientific, Inc. U.S. Patent Pending. Foreign Patents Pending.

Fracture Through the Distal Femoral Epiphysis

Laura C. Decoster, ATC, CSCS; James C. Vailas, MD

ABSTRACT: Injuries to the distal femoral epiphysis are not common, but when they do occur, at least half of them occur in sports. Many athletic trainers work with skeletally immature athletes, thereby increasing the likelihood that they will face this type of injury. The case of a 14-year-old football player who sustained a Salter-Harris III fracture of his medial femoral condyle is presented to illustrate the classic natural history and prognosis of this injury. To properly evaluate this injury, the athletic trainer must understand the anatomy of the immature skeleton and be able to recognize signs that epiphyseal injury has occurred. These injuries frequently result in long-term complications such as leg-length discrepancy, although this and other complications can be minimized or eliminated through proper immediate treatment. Athletic trainers must be aware of these injuries and include them in their differential evaluation, since immediate treatment can mean the difference between permanent leg-length discrepancy or deformity and an uncomplicated recovery with the athlete returning to full athletic activity.

algus loading of the knee joint with or without rotational forces is generally accepted as a mechanism of medial collateral ligament (MCL) and/or anterior cruciate ligament (ACL) injury. Considering this mechanism of injury and an athlete's report of hearing a "pop," an MCL/ ACL injury would likely be high on the athletic trainer's index of suspicion. In the child or adolescent athlete, however, there may be an associated or, alternately, an isolated epiphyseal fracture. Injuries at the distal femoral physis commonly cause growth disruption and may result in leg-length discrepancy.¹⁰ It is very important for athletic trainers to be aware of this injury, since at least half of all injuries at this site occur during sports activities.^{1,2,10} Physeal injury must be included in the differential evaluation of adolescent knee injuries. The following case report highlights the clinical features of a distal femoral epiphyseal injury.

CASE REPORT

A 14-year-old male (6 ft, 1 in; 180 lb) football player sustained a valgus blow to his left knee during a football game. He reported hearing a pop at the time of the blow and another upon hitting the ground. He described the sensation occurring with the second pop as "like something fell back in place." He noted immediate swelling and pain throughout the knee, and was unable to bear weight. After a brief evaluation by his coach, the athlete was evacuated from the field by ambulance.

Upon examination in the emergency room, the athlete was anxious but not in distress. There was a moderate knee effusion, no obvious deformity, and neurovascular function of the leg was normal. He was having some pain at rest. There was tenderness along the medial side of the knee, just proximal to the joint line, extending into the metaphysis. Lachman and

Laura Decoster is employed at HEALTHSOUTH Rehab, and is Director of the New Hampshire Musculoskeletal Institute at 35 Kosciuszko Street in Manchester, NH 03101.

James C. Vailas is employed in the Department of Orthopaedic Surgery at The Hitchcock Clinic, Southern Region in Manchester. valgus testing of the knee were intolerable; however, the knee was not grossly unstable.

Because of the mechanism of injury, the area of tenderness, and the presence of extra-articular swelling, an epiphyseal injury was suspected. X-rays were positive for a fracture through the medial distal femoral physis and epiphysis extending into the knee joint through the intercondylar notch (Figs 1 & 2). There was a 2- to 3-mm displacement of the fragment. This injury was classified as a Salter-Harris III fracture (Fig 3). The athlete's x-rays were also significant in that they showed him to be near skeletal maturity despite his young chronological age. His past medical history was positive for an alleged mild sprain of his left anterior cruciate ligament the previous winter, and a well-healed left distal fibula fracture at age 10. He had no continuing complaints related to either injury.

The athlete was brought to the operating room where he was anesthetized and 120 cc of blood was aspirated from the knee joint. A gentle Lachman test revealed 5 mm of laxity, with a good end point. Varus stress testing, applied to check the



Fig 1. Emergency room x-ray. Salter-Harris III fracture in a 14-yearold male after football injury. Bilateral anterior-posterior view. Note the separation of the left medial distal femoral epiphysis compared to the right.



Fig 2. Emergency room x-ray. Left anterior-posterior view. Notch view shows continuation of fracture line into the knee joint.

integrity of the lateral collateral ligament, was normal. Other ligament testing was deferred. The fracture was reduced by closed manipulation. Confirmation of satisfactory reduction was obtained by intraoperative fluoroscopy and was followed by internal fixation using a 7.5-mm screw placed percutaneously, medial to lateral, through the condyles, and a smooth pin placed distal to proximal and posterior to anterior across the growth plate (Fig 4). The incisions were dressed and bandaged and the leg was placed in a long-leg fiberglass cast. The athlete was limited to toe-touch weight bearing with crutches.

After 2 weeks, the cast was replaced with a rehabilitation brace set at 0°. The athlete was instructed to begin a home program of quad sets and gentle short-arc range-of-motion exercises. After 3 weeks, the smooth pin was removed in the office, the brace was set to allow 0° to 45° of motion, and he was referred for supervised physical therapy. During 3 weeks of therapy, his status improved to full weight bearing, range of motion 0° to 120°. His exercise program included stationary cycling, stair machine, mini-squats, lunges, step-ups, stepdowns, and comprehensive progressive resistive exercises for his legs. At 6 weeks postinjury, this motivated athlete was out of his brace and discharged from supervised physical therapy to continue strengthening and low-impact/pool exercise independently.



Fig 3. Salter-Harris Fracture Classification System. Type I: Separation of metaphysis from epiphyseal plate. Type II: Separation of metaphysis from epiphyseal plate with attached piece of metaphysis. Type III: Separation and fracture through epiphysis and epiphyseal plate. Type IV: Separation and fracture through epiphysis, epiphyseal plate, and metaphysis. Type V: Crushing injury through epiphyseal plate.



Fig 4.—Postoperative x-ray showing percutaneous fixation with screw and pin. Note good postreduction alignment.

At 3 months postinjury, manual examination indicated approximately one grade (5 mm) of MCL laxity on the involved leg compared to one-half grade on the right leg. The left leg had slightly more anterior cruciate ligament laxity than the right, with a solid end point. Because of the athlete's previous diagnosis of a minor ACL sprain, it was unclear whether this laxity was related to the current injury. Radiographs showed good healing, and the athlete was released to participate in high-impact exercise and downhill skiing. At 6 months postinjury, he competed and won as an Alpine Junior Olympic skier. Significant growth discrepancy is unlikely because this athlete was so near skeletal maturity, but he was periodically monitored over the first postinjury year. The internal screw is expected to remain in place indefinitely.

DISCUSSION

Physes, also known as growth plates, are cartilaginous and contain germinal cells that create longitudinal bone growth.¹⁰ Bone growth depends on the integrity of these cartilaginous physes found at both ends of all long bones.

The femur in the immature skeleton has three physeal plates (Fig 5). The proximal femur has two physes and the distal femur has one. The distal femoral physis is extremely important, as it is the largest and fastest growing of all growth plates, contributing 70% of femur length and 37% of leg length. Also, it is the last femoral growth plate to close, doing so between 16 and 20 years of age.⁶

The physis is considered to be the weakest point in the immature skeletal system. Despite this fact, physeal injuries account for only 20% of all fractures in children.^{3,4} Injuries to the distal femoral epiphysis are less common, representing 1% to 6% of growth-plate injuries.^{8,9} However, injuries to the distal femoral epiphysis are more common than other epiphyseal injuries at the knee.¹⁰ This may be because all major knee ligaments originate on the epiphysis, and stress to the ligaments would result in traction of the epiphysis away from the physis.

In contradiction to the widely held expectation of isolated failure through the weakest anatomical point, Bertin and Goble,² among others,^{1,7,11} have reported notable ligament



Fig 5. Skeletally immature femur. A) Apophysis, B) epiphysis, C) apophyseal plate, D) capital epiphyseal plate, E) metaphysis, F) distal femoral epiphyseal plate (physis), G) epiphysis.

laxity after healing of epiphyseal injuries about the knee. Bertin and Goble² suggested a sequence of injuries secondary to significant valgus force at the knee. First, crushing damage occurs to the lateral structures as the superficial MCL begins to stretch. Next, as continued force is applied, the superficial MCL fails, causing increasing stress on the deep MCL and the ACL, which are attached to the epiphysis. During childhood and adolescence, ligaments are stronger than bone; therefore, continued force will result in a Salter-Harris III fracture through the epiphysis and into the joint through the intercondylar notch.²

With appropriate treatment, athletes generally return to normal activities 4 to 6 months after this type of injury. Possible complications after distal femoral epiphyseal injuries include: popliteal artery and/or nerve damage, stiffness, quadriceps atrophy, persistent instability of the knee, angular deformity, and leg-length discrepancy.¹⁰ Retrospective studies of distal femoral epiphyseal injuries have shown an incidence of leg-length discrepancy between 36% and 60%.^{5,7}

Differential Evaluation

Adolescent knee injuries must be evaluated with caution. A good understanding of the mechanism of injury associated with distal femoral physeal injuries, as well as the ability to recognize telltale signs and symptoms is imperative if we hope to reduce the possibility that the evaluation process may worsen the injury.

History: As mentioned previously, the common mechanism of injury is similar to that associated with major ligament injuries at the knee, possibly including valgus, hyperextension, and rotational stresses. Pain will usually be severe and the athlete will be unable to bear weight on the affected leg.

Observation: This may or may not reveal angular deformity and ecchymosis, but will usually show rapid effusion.

Palpation: This may reveal pain and crepitus proximal to the joint line at the level of the physis, even with the top of the patella, and significant muscle spasm around the joint.

Caution: Findings such as those mentioned above, especially deformity and bony crepitus, should result in cessation of the physical examination and transportation of the athlete to a medical facility for further evaluation. The degree of separation of the growth plate seriously impacts the potential growth disturbance following these injuries.⁷ Consequently, if a distal femoral fracture or growth-plate injury is suspected, the athletic trainer should forego ligament laxity testing. Manipulation of a physeal injury, as would occur with forceful ligament testing, should be avoided.

Ligament Testing: If the athletic trainer's evaluation continues to ligament testing, he or she may find a 'soft or moist type of crepitus''¹⁰ and abnormal motion which may involve or mimic ligament injury.

Any athletic trainer who works with skeletally immature athletes must be aware of the possibility of a physeal injury. He/she should make such injuries a part of the differential evaluation of leg injuries to these athletes.

REFERENCES

- 1. Aitken AP, Magill HK. Fractures involving the distal femoral epiphyseal cartilage. *J Bone Joint Surg [Am]*. 1952;36A:96.
- 2. Bertin KC, Goble EM. Ligament injuries associated with physeal fractures about the knee. *Clin Orthop Rel Res.* 1983;177:188–195.
- Bisgard JD, Martenkson L. Fractures in children. Surg Gynecol Obstet. 1937;65:464.
- Compere EL. Growth arrest in long bones as result of fractures that include the epiphysis. JAMA 1935;105:2140.
- Grana WA. Injuries to the knee. In: Sullivan JA, Grana WA, eds. *The Pediatric Athlete*. Park Ridge, IL: American Academy of Orthopaedic Surgeons; 1990:178–179.
- Heinrich SD, Finney T, D'Ambrosia RD. Bony injuries about the knee. In: MacEwen GD, Kasser JR, Heinrich SD, eds. *Pediatric Fractures. A*

Practical Approach to Assessment and Treatment. Baltimore, MD: Williams & Wilkins; 1993:296–302.

- Lombardo SJ, Harvey JP. Fractures of the distal femoral epiphysis. J Bone Joint Surg [Am]. 1977;59A:742.
- Neer CS II, Horowitz BS. Fractures of the proximal humeral epiphyseal plate. *Clin Orthop Rel Res.* 1965;41:24–31.
- 9. Peterson CA, Peterson HA. Analysis of the incidence of injuries to the epiphyseal growth plate. *J Trauma*. 1972;12:275–281.
- Roberts JM. Fractures and separations of the knee. In: Rockwood CA, Wilkins KE, King RE, eds. *Fractures in Children*. Philadelphia, PA: JB Lippincott Company; 1991;3:891–917.
- Stephens DC, Louis E, Louis DS. Traumatic separation of the distal femoral epiphyseal cartilage plate. J Bone Joint Surg [Am]. 1974;56A: 1383.



Aircast's atest Innovation is a

(But not an ordinary strap)

In 1978 Aircast® introduced the Air-Stirrup® brace-the first off-the-shelf ankle stirrup. Since then, dozens of improvements have been made. Eight of these were worthy of patents.* Swivel-Strap[™] is the latest.

> This is not an ordinary strap. Its molded hook Velcro® is smoother to the touch but holds even better. Lab tests show attachment to the shell is stronger. And clinical trials show patient preference is universal.

> > AURCAST



Swivel-Strap swivels. So it wraps anatomically and permits counter rotation. Narrowed hook Velcro® is always covered by the strap. No more snags.

*Aircast innovations in ankle brace design:

- 1. 1978. First Prefabricated ankle stirrup. "The breakthrough in ankle management." Patent 4,280,489**
- 2, 1978. Flexible-Hinge Heel-Pad. Improves durability, comfort and fit. Patent 4,280,489
- 3. 1980. Self-Sealing Valve. Makes adjustable aircell convenient. Patent 4,287,920
- 4. 1985. Pre-inflated Aircell. Makes adjustment unnecessary-but possible. Patent 4,628,945 5. 1985. Duplex Aircell. Graduated compression, enhanced pulsation, edema control. Patent 5,125,400
- 6. 1992. Long-Life Heel Pad. Virtually eliminates wear and fraying. Patent Pending 7. 1992. Molded-in-Place Hook Fastener. Stronger Velcro attachments. Patent Pending
- 8. 1992. Swivel-Strap. Anatomic Alignment. Snag free. Patent Pending
- **The scope and validity of this patent was affirmed in a U.S. District Court in January, 1992.

PO BOX 709 • SUMMIT, NJ 07901 1-800-526-8785 • (908)273-6349 • FAX(800)457-4221



AT/SU95

The Effects of Prophylactic Knee Bracing on Running Gait

C.L. Liggett, MS; R.D. Tandy, PhD; J.C. Young, PhD

ABSTRACT: Although the use of prophylactic knee braces in football players is common, the effectiveness of this practice is questionable. Some studies have actually shown an increase in the incidence of lower extremity injuries in players wearing such braces. The purpose of this study was to determine if wearing a prophylactic knee brace (Omni Anderson Knee Stabler) caused an alteration in a normal running gait pattern that might then increase the risk for injury. Ten subjects with no prior history of knee injury or brace use were filmed in two planes while running on a treadmill at 5 mph. Two-dimensional digital

he increasing incidence and severity of injuries to the knee joint in football have led to the use of knee braces designed to prevent valgus loads to the medial aspect of the knee from lateral impact to the joint. The evidence for the effectiveness of such prophylactic bracing is, however, equivocal. Although some studies report a favorable effect of knee bracing on the occurrence of knee injuries, 4,13,14 others report the same or an increased number of injuries in players wearing prophylactic braces.^{4,8,10,12} In addition to an increased incidence of injuries to the knee, a study of high school football players found a greater incidence of injuries to the foot and ankle in players wearing such knee braces.⁶ The increased incidence of injuries with prophylactic knee bracing may be due to limitations placed on functional performance by the knee brace. A slower sprint speed and decreased agility have been reported with prophylactic braces versus nonbraced conditions.³ Peak torque at 60°/sec and 240°/sec was also less when prophylactic knee braces were worn.1 Decreased functional performance and increased injuries to nonbraced joints in the braced limb suggested that gait may also be altered by wearing a prophylactic knee brace. Therefore, the purpose of this study was to determine whether wearing a prophylactic knee brace designed to prevent valgus stress to the knee joint from lateral impact (Omni Anderson Knee Stabler, Omni Scientific Inc, Lafayette, IL) affected the duration of the gait cycle, or the range of motion or velocity of the knee, hip, and ankle joints while running on a treadmill.

METHODS

Ten subjects, four men and six women $(25 \pm 1 \text{ yr})$, agreed to participate in this study. The University of Nevada, Las Vegas Institutional Review Board reviewed and approved this study, and all subjects gave informed consent. None of the subjects had a previous knee injury or prior experience wearing

C. L. Liggett, R.D. Tandy, and **John C. Young** are associated with the Department of Kinesiology at the University of Nevada, Las Vegas at 4505 Maryland Parkway in Las Vegas, NV 89154–3034.

analysis of each subject's running gait with and without the use of knee braces was performed. The duration of the gait cycle and the range of motion and velocity of movements at the knee, hip, and ankle joints were determined in each leg for each condition. No differences were found between braced and nonbraced conditions for any of the measured variables. Therefore, we conclude that the use of the Omni Anderson Knee Stabler does not alter gait pattern of the lower extremities while running on a treadmill.

prophylactic knee braces, and all had prior experience running on a treadmill. Before testing, we measured height (172.4 \pm 2.3 cm), weight (70.7 \pm 3.0 kg), and estimated percentage of body fat (19.3 \pm 1.2%) from skinfold measurements.⁵ Then we applied markers (white athletic tape with a black dot in the center) to enhance the digitizing procedure. The sites marked were the right and left ankles, knees, hips, shoulders, elbows, hands, and balls of the feet. We placed markers anteriorly and posteriorly over the center of the articulating surfaces based on the relevant bony and soft tissue landmarks for each site.

Before each subject arrived for testing, two video cameras (frequency 60 Hz; 60 fields per second) were positioned 11 feet from a motor-driven treadmill at 45° angles to the center of the treadmill belt to give an anterior and a posterior view of the subject for digitizing (Fig 1). Cameras were set to manual focus and shutter speed was set at 1/1000 second. A control



Fig 1. Placement of video cameras in relation to the treadmill. Cameras were positioned to provide an anterior and a posterior view of the subject for digitizing.

points cube (188 cm \times 193 cm \times 95 cm) used as a reference for the computer analysis system was placed on the treadmill and filmed before each subject being tested. Subjects ran on the treadmill at 5 mph with and without a knee brace. The order of trials was randomized between subjects. The same athletic trainer, who was experienced in applying braces for athletic competition, applied the Omni Anderson Knee Stabler for all subjects according to the manufacturer's recommendations. Subjects warmed up briefly; then treadmill speed was increased to 5 mph. Subjects ran for 3 to 5 minutes, during which time we filmed three continuous 30- to 60-second segments of running. Cameras were synchronized by a visual marker before each segment to ensure that the same gait cycle was analyzed from each tape. After completion of the third segment of filming, the cameras were stopped, the subject was taken off the treadmill, and the control points cube was refilmed. Subjects then performed the second trial.

Video tapes were digitized using an Ariel system (Ariel Life Systems, Inc, San Diego, CA). A set number of frames of each view, front and back, from the same segment along with a frame of the control points cube was digitized. Videotape images were converted into digital images using frame-byframe manual digitizing of the subject. The Ariel System then transformed the digitized image into a stick figure with minimal smoothing using a cubic spline smoothing algorithm. A two-dimensional analysis of the kinematic data was performed, and graphs for range of motion and velocity of the knee, hip, and ankle joints were generated.

We analyzed data for range of motion and velocity for a single-gait cycle separately using a factorial ANOVA with repeated measures of time. The designs were 3 (joints: knee, hip, and ankle) \times 2 (side: right and left) \times 2 (brace: with and without) \times 8 (time from 0 to 0.7 sec, every tenth of a second). We determined differences in gait cycle duration between braced and nonbraced conditions by paired *t*-test.

RESULTS

The duration of the gait cycle was not affected by wearing a knee brace. The gait cycle was 0.77 ± 0.01 seconds in the braced condition compared with 0.79 ± 0.01 seconds in the nonbraced condition. Range of motion for each joint (knee, hip, and ankle) was compared for both braced and nonbraced conditions in both right and left legs. No significant differences in range of motion for any joint were found between braced and nonbraced conditions. When plotted together and synchronized for time, range of motion shows little variation between legs and conditions (Fig 2). Velocities of movement around the knee, hip, and ankle joints were compared for braced and nonbraced conditions in both right and left legs. Velocity did not differ between conditions for any joint in either leg (Fig 3).

DISCUSSION

The effectiveness of the Omni Anderson Knee Stabler in preventing knee injuries in college football players was examined by Hansen et al.⁷ They found an injury incidence rate of 6.1 per 100 players during the control period in which players



Fig 2. Range of motion for knee, hip, and ankle joints for right (\Box, \blacksquare) and left (\bigcirc, \bullet) legs in both braced and nonbraced conditions for one gait cycle. Open symbols represent braced condition and closed symbols represent nonbraced condition.

did not use the knee brace. During the period of brace use, the injury incidence rate was 7.45 per 100 players. In addition, the number of surgeries almost doubled during the braced period compared with the nonbraced or control period.⁷ These results suggested that the Omni Anderson Knee Stabler, rather than preventing knee injuries, may actually increase the risk of injury in players using the brace. Our study attempted to determine whether the normal running gait is altered by wearing this type of knee brace. An alteration in gait may result in a redistribution of forces in the lower leg, predisposing the wearer to injury. We found only minimal differences in range of motion and velocity for the ankle, knee, and hip joints between braced and nonbraced conditions. The duration of the gait cycle was similarly unaffected by knee bracing.

Dowd et al (unpublished data, 1990) reported that the same patterns of gait are produced in repeated trials, suggesting that a difference in gait as a result of wearing a knee brace would be detectable. We demonstrated that the wearing of a prophylactic knee brace on each knee did not change the overall timing of the gait cycle or the range of motion at the knee, hip, and ankle joints. The values obtained for both gait cycle duration and range of motion at the hip, knee, and ankle are similar to those reported by Knutzen et al⁹ and Devita et al,² who found no change in gait with functional bracing of one knee. Devita et al² suggested that if the time between brace application and gait analysis was too long, subjects would adapt to the brace and adopt a new gait. The adopted gait



Fig 3. Velocity of movement of knee, hip, and ankle joints for right (\Box, \blacksquare) and left $(\bigcirc \bullet)$ legs in both braced and nonbraced conditions. Open symbols represent braced condition and closed symbols represent nonbraced condition.

would then become the subject's normal gait, which would explain why no difference between gait was found in braced and nonbraced legs.² Evidence for this is found by comparing running speed and agility in experienced and naive knee brace wearers using a prophylactic knee brace.³ Only speed was decreased in subjects with knee brace experience, whereas both agility and speed were altered in inexperienced wearers. The results of the present study indicate that gait was not affected by the Anderson Knee Stabler in subjects who had no previous experience wearing knee braces.

One important aspect of brace application is proper positioning of the brace on the subject. Regalbuto et al¹¹ showed that braces placed incorrectly or positioned improperly caused changes in the forces generated at the knee joint. In the present study, the same individual applied the braces according to manufacturer's recommendations. The slight differences in velocity of movement at the lower extremity joints are more likely due to variability in digitizing the data. The variability present tended to occur between the right and left leg and not between the braced and nonbraced conditions. Although the subjects were filmed with two cameras, the filming was done from the subject's left side, so that there were moments in each gait cycle when markers for the right leg were blocked from view, and interpolation was necessary. The velocity of movement is affected to a greater extent than range of motion, since a mark located behind where it should be would show the joint slowing in velocity or even starting to change direction early. In keeping with this, greater variability was seen in the swing phase of the gait cycle where more movement was occurring than in the support phase.

In conclusion, this study indicates that the Omni Anderson Knee Stabler does not adversely affect gait in subjects running on a treadmill. Thus, the increased incidence of injuries reported for subjects wearing this brace⁷ must be attributed to other factors. These factors remain to be elucidated.

REFERENCES

- Borsa PA, Lephart SM, Fu FH. Muscular and functional performance characteristics of individuals wearing prophylactic knee braces. J. Athl Train. 1993;28:336–344.
- Devita P, Hunter PB, Skelly W. Effect of a functional knee brace on the biomechanics of running. *Med Sci Sports Exerc.* 1992;24:797–806.
- Fujiwara LM, Perrin DH, Buxton BP. Effect of three lateral knee braces on speed and agility in experienced and non-experienced wearers. *Athl Train*, *JNATA*. 1990;25:160–161.
- Garrick JG, Regua RK. Prophylactic knee bracing. Am J Sports Med. 1987;15:471–476.
- Golding LA, Myers CR, Sinning WE, eds. The Y's Way to Physical Fitness. 3rd ed. Champaign, IL: Human Kinetics Publishers; 1989:77.
- Grace TG, Skipper BJ, Newberry JC, Nelson MA, Sweetser ER, Rothman ML. Prophylactic knee braces and injury to the lower extremity. *J Bone Joint Surg [Am]*. 1988;70A:422–427.
- Hansen BL, Ward JC, Diehl RC. The preventive use of the Anderson knee stabler in football. *Phys Sportsmed*. Sep 1985;13:75–81.
- Hewson GF, Mendini RA, Wang JB. Prophylactic knee bracing in college football. Am J Sports Med. 1986;14:262–266.
- Knutzen KM, Bates BT, Schot P, Hamill J. A biomechanical analysis of two functional knee braces. *Med Sci Sports Exerc.* 1987;19:303–309.
- Paulos LE, Drawbert JP, France P, Rosenberg TD. Lateral knee braces in football: do they prevent injury? *Phys Sportsmed*. Jun 1986;14:119–126.
- Regalbuto MA, Rovick JS, Walker PS. The forces in a knee brace as a function of hinge design and placement. Am J Sports Med. 1989;17:535– 543.
- Requa RK, Garrick JG. A review of prophylactic knee braces in football. *Pediatr Clin North Am.* 1990;37:1165–1173.
- Rovere GD, Haupt HA, Yates CS. Prophylactic knee bracing in college football. Am J Sports Med. 1987;15:111–116.
- Sitler M, Ryan J, Hopkinson W, et al. The efficacy of a prophylactic knee brace to reduce knee injuries in football: a prospective, randomized study at West Point. Am J Sports Med. 1990;18:310–315.

with Simethicone INSTYDOSE

EACH & ml. CONTAINE! Auminum Hydroxide (Equity to Dried Ge

medique

CUQUE GUAIFICON.DMS

1596717

TNAUS FOR NA

WITHU

UnitDose, the Athletic Trainers' Smart Choice for Liquid Medications

AKICON II 30

Convenient

Single dosage, quick, easy-to-use, twist open tubes for instant administration with no pouring, spills or mess. Fits easily into training bags or kits.



Hygienic

Tamper resistant, sanitary, no cross contamination or transfer of body fluids. No unsanitary spoons or cups.



INSTYDOSE

Safe

Unit dose products are hygienic, sanitary, sugar-free, alcohol free and pre-measured. To help you get your athletes safely back in the game.





	COME SEE US AT BOOTH #420						
Medique Product	Formula	Consumer Advertised Brand	I NDC Number	Tube Count	Tube Contents		
Nausatrol Sodium Free	Dextrose 1.87g. Levulose 1.87g. Phosphoric Acid 21.5mg.	Emetrol	112-42	16	30ml.		
Diotame Sugar Free	Bismuth Subsalicylate - 524mg. / 30ml.	Pepto Bismol	104-42 104-12	50 10	30ml.		
Aldroxicon I Sugar Free	Alum. Hydroxide 1200mg. Mag. Hydroxide 1200mg. Simethicone 120mg.	Mylanta	107-42 107-12	50 10	30ml.		
Aldroxicon II Sugar Free	Alum. Hydroxide 2400mg. Mag. Hydroxide 2400mg. Simethicone 240mg.	Mylanta II	108-42 108-12	50 10	30ml.		
Guaificon DM Drowsiness Free	Guaifenesin 200mg. Dextromethorphan HBR 20mg. } 10ml	Robitussin-DM	110-52 110-12	50 10	10ml.		
Guaificon DMS Sugar Free - Alcohol Free	Guaifenesin 200mg. Dextromethorphan HBR 20mg. } 10ml	Robitussin-DM	217-52 217-12	50 10	10ml.		

COME SEE US AT BOOTH #426

Toll Free (800) 634-7680 Also from Medique

BACK PAIN-OFF

The strongest tablet for inflammation and pain relief that is available without a prescription.

Drowsiness Free - Sugar Free Lactose Free - Aspirin Free

Quantity	Product No.
500 Tablet Box	07313
200 Tablet Box	07347
100 Tablet Box	07333

Medique offers a wide variety Occupational Health products.

Thoracic Compression Fracture in a Basketball Player

Vicki L. McHugh-Pierzina, ATC; Debra A. Zillmer, MD, PT; Charles E. Giangarra, MD

ABSTRACT: Thoracolumbar pain is a frequent complaint of many athletes, but the cause is often difficult to diagnose. Compression fractures of the spine are rarely seen in athletics and are not always recognized as a potential cause of the symptoms. Reported here is a case of a T12 compression fracture in a male basketball player. Plain films revealed the percentage of loss of vertebral body height, thereby determin-

ing the stability of the fracture. If treated with a thoracolumbar spinal orthosis brace and activity restrictions, stable compression fractures heal without surgical intervention and athletes can return to activity within a number of months. Athletic trainers and physicians should maintain a level of suspicion for this injury when violent trunk flexion or lateral flexion is the mechanism of injury.

The population and occurs in all types and ages of sporting participants. Stress fractures, muscle strains, and disc disease are frequent causes of thoracolumbar pain and are often the diagnosis. An extensive literature search showed no reported cases involving thoracic fractures associated with basketball or sports activity alone.^{1,8,9,14} The goal of this paper is to report one case of a T12 compression fracture involving a basketball player we treated. We hope this report will alert others to the nature and mechanism of this unusual athletic injury and enhance early treatment efforts.

CASE STUDY

An 18-year-old male basketball player fell onto the basketball court while rebounding. He landed in a seated position with the opposing player coming down on his back, forcing his torso into flexion. He complained of immediate back pain and was not able to continue playing. He had no prior history of injury to this area and no neurological complaints.

Physical examination immediately following the injury revealed point tenderness over T12. No motor or sensory deficits were present. The athlete felt pain at end range of all spinal motion. However, there was no limitation of motion. Axial compression and distraction produced no pain. A physician examined the athlete several days later, and x-rays (see Figure) revealed a significant T12 compression fracture with 30% to 40% loss of height of the vertebral body.

Treatment consisted of placing the patient in a thoracolumbar spinal orthosis of the clamshell type for 3 months. This was done to prevent further collapse secondary to postural forces. The patient returned 4 days later to ensure that no further collapse had occurred. The orthosis maintained the spine in an extended position while allowing a comfortable gait. Rehabilitation for the patient over the next 4 weeks consisted of speed



Lateral roentgenogram 1 week postinjury. Note anterior wedging of vertebral body.

walking, stationary biking with the handlebars upright, and high repetition very low resistance-type weight lifting for the lower extremities only.

At 1 month postinjury, the above-mentioned rehabilitation continued and we upgraded it as follows. The athlete began lifting a maximum of 20 lb with his quadriceps and 10 lb with his hamstrings. He then began upper extremity weight-lifting

Vicki L. McHugh-Pierzina is an athletic trainer in the Sports Medicine Section of the Gundersen Clinic, Ltd. at 1836 South Avenue in La Crosse, WI 54601.

Debra A. Zillmer and **Charles E. Giangarra** are in private practice at the Gundersen Clinic.

activities with a 5-lb restriction. These restrictions were imposed because greater weight would require more muscle recruitment, thus placing more stress on the spinal column. At 2 months postinjury, a gradual weaning from the thoracolumbar spinal orthosis began. Light to moderate activity, excluding running and jumping, is acceptable at this time. At 3 months postinjury, the athlete was completely weaned from the thoracolumbar spinal orthosis brace.

The plan discussed with the patient consisted of restricting vigorous activities and working on range of motion and gentle strengthening of the trunk muscles. At 4 months postinjury, the athlete returned to full activity as tolerated. The only restrictions placed on him were to avoid weight-lifting practices that involved hyperflexion of the spine, and maximal squat exercises. By 6 months postinjury, x-rays revealed a clinically healed T12 compression fracture with 30% to 40% loss of vertebral body height.

DISCUSSION

After a thorough literature search, the only case we could find involving thoracic spine injuries attributed to basketball or sports activity was that of a tobogganing accident that involved anterior flexion.^{1,8,9,14}

It is commonly accepted that compression fractures are caused by anterior or lateral flexion forces, which cause failure of the anterior vertebral column.^{5,13} According to Denis,⁵ the spine is divided into three columns: anterior, middle, and posterior. The anterior column consists of the anterior longitudinal ligament, the anterior annulus fibrosus, and the anterior part of the vertebral body. The middle column consists of the posterior longitudinal ligament, the posterior annulus fibrosus, and the posterior column is formed by the posterior bony complex (posterior arch), along with the posterior ligamentous complex.

A compression fracture will cause failure of the anterior column, while the middle column remains intact and distraction occurs at the posterior column. Of great importance in distinguishing compression fractures from other vertebral fractures is the fact that the middle column remains intact. An unstable compression fracture is characterized by a posterior ligamentous complex disruption, thereby allowing the vertebra to buckle around the intact middle column. In comparison, a stable compression fracture has an intact posterior column.⁵

Until this documented case, an anterior flexion mechanism in athletics was not reported to generate a compression fracture. Only 15% to 20% of thoracolumbar-level fractures involve neurologic injury that would be evident on neurologic examination, making detection more difficult.^{2,3} This is due to the fact that compression fractures only involve the anterior column, are normally stable, and generally cause no spinal cord trauma.^{5,13} Bony tenderness over the spinous process at the involved level is the key indicator of injury. Diagnosis is confirmed by x-ray.

This case involved a 30% to 40% loss of vertebral body height and was considered stable. However, at a 50% or greater

loss of vertebral body height, the spinal segment will fail with weight bearing and, therefore, should be considered unstable. $^{10-12}$

The standard approach for management and treatment of stable thoracolumbar compression fractures has been nonoperative.^{4,6,7} These fractures should be treated symptomatically. This involves allowing early ambulation in a hyperextension orthosis such as the thoracolumbar spinal orthosis described previously.¹³ However, when greater than 50% of vertebral body height is lost, a hyperextension cast is usually required; occasionally, open reduction and internal fixation are also deemed necessary.¹³

T12 compression fractures are unusual fractures in athletics, but should be considered in athletes injured by a violent anterior or lateral flexion mechanism. Most thoracic compression fractures are stable and involve no neurological deficits. An x-ray will verify the diagnosis of a fracture. The athlete can return to sporting competition after appropriate treatment. If injuries are recognized and treated properly initially, most patients will recover with no long-term sequelae.

REFERENCES

- Bailes J, Hadley MN, Quigley MR, Sonntag VKH, Cerullo LJ. Management of athletic injuries of the cervical spine and spinal cord. *Neurosur*gery. 1991;29:491–496.
- Braford DS, Akbarnia BA, Winter RB, Seijeskog EL. Surgical stabilization of fracture and fracture-dislocation of the thoracic spine. *Spine*. 1977;2:185–196.
- Braford DS, McBride G. Thoracic/lumbar spine fractures with incomplete neurologic deficit: a correlative study of the adequacy of decompression vs. neurologic return. *Orthop Trans.* 1984;8:159.
- Davies WE, Morris JH, Hill V. An analysis of conservation (non-surgical) management of thoracolumbar fractures and fracture-dislocation with neural damage. J Bone Joint Surg [Am]. 1980;62A:1324–1328.
- Denis F. The three-column spine and its significance in the classification of acute thoracolumbar spinal injuries. *Spine*. 1983;8:817–831.
- Frankel HL, Hancock DO, Hyslop G, et al. The value of postural reduction in the initial management of closed injuries of the spine with paraplegia and tetraplegia: Part I. *Paraplegia*. 1969;7:38–58.
- Guttmann L. Spinal deformities in traumatic paraplegics and tetraplegics following surgical procedures. *Paraplegia*. 1993;12:449–463.
- Haher TR, O'Brien M, Kauffman C, Liao KC. Biomechanics of the spine in sports. *Clin Sports Med*. 1993;12:449–463.
- Lehman LB. Preventing and anticipating neurologic injuries in sports. Am Fam Physician. 1988;38:181–184.
- Montesano PX. Anterior approach to fractures and dislocations of the thoracolumbar spine. In: Chapman M, ed. *Operative Orthopaedics*. Philadelphia, PA: JB Lippincott; 1988:1905–1916.
- Nagel DA, Koogke TA, Piziali RL, Perkash I. Stabilizing of the upper lumbar spine following progressive disruptions and the application of individual internal and external fixation devices. *J Bone Joint Surg. [Am]* 1981;63A:6270.
- Nash CL Jr, Schatzinger LH, Brown RH, Brodkey J. The unstable stable thoracic compression fracture: its problems and the use of spinal core monitoring in the evaluation of treatment. *Spine*. 1977;2:261–265.
- Rockwood CA Jr, Green DP, Bucholz RW. Rockwood and Green's Fractures in Adults. 3rd ed. Thoracolumbar Spine: Part II. Philadelphia, PA: JB Lippincott; 1991:1358–1397.
- Tall R, DeVault W. Spinal injury in sport: epidemiologic considerations. *Clin Sports Med.* 1993;12:441–447.
- Whitesides TE Jr. Traumatic kyphosis of the thoracolumbar spine. *Clin* Orthop. 1977;128:78–92.

Introducing Foot Management's PER the



Designed for the patient that needs Longitudinal Arch Support and Maximum Biomechanical Control. Manufactured from a rigid Polypropulene with an extrinsic Rearfoot Posting. Standard Length is to the Metatarsal Heads. Available in Sport or Street models.

Designed for the patient that needs shock absorption as well as Biomechanical Control. Manufactured from a dense Eva Foam. Standard lengths are to the Toe Crest or Metatarsal Heads. Available in Sport or Street models.



FLAT RATE PRICES FOR COST CONTAINMENT

Modified: \$64.00/ pair (extensions and/or modifications)

Standard: \$54.00/ pair Bio-Foam® Trays: \$28.00/ case Free Return UPS Ground Shipping Free Shipping Cartons Available

Foot Management still offers its full line of Specialty Orthotics

7201 Friendship Road • Pittsville, MD 21850 • 1-800-HOT FOOT • FAX 410-835-3494



Outback Secrets International



What do these sports trainers'...

OTHO DAVIS - Philadelphia Eagles, DOUG ATKINSON - Dallas Mavericks KEVIN JOHNSON - Washington Bullets and, KEITH JONES - LA Clippers

... have in common?

They have formed an association with a product that is revolutionizing sports therapy. Emu Oil is taking the professional sports arena by storm. Emu Oil aids in the recovery process of muscular aches and strains and quickly helps to reduce swelling and pain from damage to joints and tissue. Here are what some trainers and leading researchers have to say...

" I put it on and it works magic!" Otho Davis, Philadelphia Eagles.

"...using the oil in conjunction with my ultrasound treatment...enhances pain-relieving... reduces swelling (like I have never seen before)." *Keith Jones, Los Angeles Clippers.*

" I use Emu Oil daily and my players use the oil 2 or 3 times daily... We apply Emu Oil to every sprain or strain..." *Doug Atkinson, Dallas Mavericks.*

"...ultra-sound and muscle stem are beneficial (and), Emu Oil is miraculous...when used together, they are awesome!" *Dr. E. Headley.*

...these are only a few of the many great things being said about Emu Oil.

JOIN OUR WINNING TEAM

and

TAKE ADVANTAGE OF AN OPPORTUNITY WITH ENORMOUS POTENTIAL

I would like to see ifPlease send me more	qualify for your Trainers Recruitment Program. e information on your company and products.
Name	Phone
Address	
City	StateZip
Mail to: OUTBACK SECRE 3905 LINDBERG	S INTERNATIONAL, INC. DR., DALLAS, TX. 75255
Interrater Reliability of Isokinetic Measures of Knee Flexion and Extension

Douglas R. Keskula, PhD, PT, ATC; Jeffrey S. Dowling, MHE, PT; Virginia L. Davis, MEd, PT, ATC; Paula W. Finley, PT; Daniel L. Dell'Omo, ATC

ABSTRACT: The purpose of this investigation was to determine the interrater reliability of peak torque and total work values obtained with isokinetic measures of knee flexion and extension. Eight male and eight female students were evaluated on four occasions by four different examiners (range of isokinetic test experience: 0 to 10 yrs) using a standardized isokinetic measurement protocol. Subjects were randomly assigned to participate in a test sequence determined by a 4×4 balanced Latin square. Peak torque and total work values at 60°/sec and 180°/sec were obtained for the concentric measures of knee extension and flexion. The measures of peak torque and total work were corrected for the effects of gravity.

I sokinetic assessment of human muscle performance is an integral component of clinical practice in many settings. The use of computer-controlled isokinetic devices provides clinicians with a means to objectively assess and document muscle performance using a variety of test procedures. Measures are used in the clinical decision-making process and the amount of error associated with these measures is an important consideration.¹⁴ Consistent and accurate data from isokinetic testing would serve to organize and implement effective rehabilitation programs.

Clinicians need to be concerned with the stability of measures with respect to time and the evaluator. The assumption is that variations between measures are attributed to changes in the variable being measured. However, random measurement error may contribute to this variation, reducing the reliability of the test. There are several sources of measurement error that diminish the reliability of isokinetic testing. These factors may include flaws with the measurement tool, inherent instability of the variable being measured, and errors made by the examiner.^{2,13,14}

Within the clinical environment, several sources of error can be controlled, thereby improving reliability. Appropriate calibration and maintenance of the dynamometer may serve to minimize measurement error due to mechanical problems. If the measure of interest is error-prone, a decision may be made as to the value of its use.² Careful planning, clear operational

Daniel L. Dell'Omo is an athletic trainer at Tuckahoe Physical Therapy Corporation in Richmond, VA. Intraclass correlation coefficients and standard error of measurement estimates were used to estimate the interrater reliability for each test condition (test speed \times muscle group). Intraclass correlation coefficient values ranged from .90 to .96 for peak torque and .90 to .95 for total work. Standard error of measurement estimates ranged from 8.9 to 13.3 Nm for peak torque and 11.3 to 16.8 Nm for total work. The results of this investigation demonstrate that reliable measures of isokinetic muscle performance of knee extension and flexion may be obtained by four clinicians with varied experience when following a standardized measurement protocol.

definitions, and standardization of test procedures can minimize the effect of additional sources of measurement error.^{2,13} Treddinick and Duncan¹⁸ reported that acceptable intrarater reliability of isokinetic measures of knee extension were obtained by using a precise test protocol.

In the clinical setting, repeated measurements may be taken by the same or different examiners. Variability may be present in the communication of test instructions, subject positioning, and joint axis alignment,^{1,15} unpredictability of the test environment,¹³ and examiner's adherence to a standardized measurement protocol. All of these factors may contribute to measurement error, thus reducing reliability. Variations in test procedures employed by different examiners may contribute to measurement error, to a greater extent than with repeated tests performed by the same examiner.

There are numerous reports of intrarater reliability of isokinetic measures in the literature^{6,8,9,11,12,18}; however, there are limited reports of interrater reliability of isokinetic measures.⁷ The primary objective of our investigation was to determine the interrater reliability of an isokinetic measurement protocol designed to assess concentric knee extension and flexion.

METHODS

We used a repeated-measures design, with the repeated factor being subject scores obtained by multiple raters. A different examiner evaluated subjects during each test session using the same isokinetic device. Isokinetic measures of peak torque and total work were obtained on 16 subjects during the four test sessions. We assessed subjects using a standardized isokinetic measurement protocol to evaluate concentric muscle performance of the quadriceps and hamstrings at test speeds of 60°/sec and 180°/sec.

Eight men and eight women (age = 25.4 ± 4.5 yr, ht = 174.2 ± 9.1 cm, wt = 73.4 ± 16.9 kg) from the student

Douglas R. Keskula is an assistant professor in the Physical Therapy Program at the Medical College of Georgia in Augusta, GA 30912-3209. **Jeffrey S. Dowling** is an Assistant Director of Physical Therapy in the Medical College of Georgia Hospital and Clinics.

Virginia L. Davis is a clinical supervisor and Paula W. Finley is a staff physical therapist in the Sports Medicine Program at the Medical College of Georgia Hospital and Clinics.

population at the Medical College of Georgia volunteered to participate in this investigation. Subjects reported no significant history of dominant lower extremity pathology. We determined lower extremity dominance by asking subjects which leg they used in performing gross motor activities, such as kicking a ball. We informed subjects of the procedure and inherent risks of the investigation, and they signed an informed consent form in accordance with institutional human investigation committee guidelines.

The examiners participating in this investigation were clinicians employed full-time by the Physical Therapy Department of the Medical College of Georgia. Examiners received isokinetic test protocol instruction from the clinical supervisor and were provided an opportunity to practice the test procedure before the actual test sessions. Characteristics of the examiners are presented in Table 1.

The Cybex 6000 (Division of Lumex, Ronkonkoma, NY) was used to measure concentric contractions of the quadriceps and hamstrings of the dominant knee. We corrected measures of peak torque and total work for the effects of gravity. We calibrated the dynamometer before investigational data collection in accordance with the manufacturer's guidelines. Subsequent calibration of the device was approximately 30 days later, in concert with the institutional protocol. We collected all data within the 30-day period, between the two calibration sessions.

We randomly assigned subjects to be evaluated by each of the four examiners over a 3-week period. We determined the test sequence by a 4×4 balanced Latin square to control for the effect of test order.¹³ There were 3 to 5 days between test sessions and we made every effort to maintain consistency with respect to the time of day the tests were administered. We made no effort to control the activity of subjects between test sessions. Examiners were unaware of a subject's past test performance.

During the first evaluation session, the examiner provided each subject with a brief orientation to the Cybex testing system. The subject was positioned on the testing system and the joint axis was aligned with the axis of the dynamometer. We used the center of the lateral femoral condyle as the axis of rotation. Seat adjustments were made to accommodate the axis alignment. The shin pad of the lever arm was positioned proximal to the ankle. We recorded the following information: seat back tilt, seat depth, dynamometer height, fore and aft, and the length of the shin pad from the axis. Positioning information was available to subsequent examiners to facilitate consistency of subject positioning.

We used a standard facility-based isokinetic knee evaluation protocol to assess performance of the knee musculature from 90° of flexion to 0° of extension. The test protocol consisted of four maximal voluntary concentric repetitions of the knee extensors and flexors at 60°/sec followed by 20 repetitions at 180°/sec. There was a 20-second rest provided between testing velocities. Warm-up contractions preceded the test of maximal effort. The warm-up consisted of four submaximal contractions at each test speed. A 20-second rest interval was given between warm-up and testing. Before isokinetic measurement, all subjects participated in a general lower extremity warm-up. The warm-up consisted of 5 minutes of submaximal exercise on a Fitron (Cybex, Division of Lumex, Ronkonkoma, NY) at 60°/sec. The same measurement protocol was reproduced for each of the testing sessions.

We used trunk, hip, and thigh stabilization during the warm-up and testing repetitions. During tests of maximal contractions, subjects were instructed to use their upper extremities and contralateral lower extremity to provide stabilization with the available hand grips and leg pad. Verbal encouragement was not used during warm-up or test repetitions because of the difficulty in providing consistent feedback across subjects and test sessions. However, we provided subjects with verbal orientation to their activity during the 20-repetition component of the test. For example, we told subjects they had completed 5, 10, 15, and 20 repetitionss during the test. We provided subjects with visual feedback with the Cybex computer monitor during warm-up and test repetitions.

We compiled four sets of peak torque and total work data that represented the subjects' isokinetic measurements obtained by the four examiners. We further categorized data by test speed and muscle group. We calculated means and standard deviations for peak torque and total work for examiners 1 through 4 for each test condition (test speed and muscle group). We obtained all peak torque and total work data from the Cybex computer-generated isokinetic short report. Peak torque and total work data represent the highest value from the test repetitions performed by each subject for each test condition.

To determine the interrater reliability of the isokinetic measurements within this sample, we calculated intraclass correlation coefficients (ICCs) for subjects across the four

I	abl	e 1	•	Charact	teristic	cs of	Exami	ners	

	А	В	С	D
Clinical Background	Orthop & Spts Med	Acute Care	Orthop & Spts Med	Spts Med
Number of Years at this facility	2	3	3.5	>1
Number of Years of Clinical Experience	4.5	4.5	3.5	10
Number of Years of Isokinetic Testing Experience	3	0	1	10
Number of Years of Cybex Testing Experience	1*	0	1	0*
Frequency of Cybex Isokinetic Tests Per Week	>2	0	>2	0

* Additional experience was with Kin-Com isokinetic system.

examiners according to the Shrout and Fleiss equation (2, 1).¹⁶ We calculated individual ICCs for peak torque and total work for each test condition (muscle group and test speed) using a two-way repeated measures ANOVA. All eight ICCs were computed using the ICC.BAS basic program developed by Delitto and Strube.²

To describe the precision of measurement between the four examiners, we computed standard error of measurement (SEM) estimates. Unlike the ICC, the SEM possesses the unit of measure and provides the opportunity to calculate a range where the subject's true score is located. We calculated individual SEM for peak torque and total work for each test condition (muscle group and test speed). We calculated the SEM by multiplying the standard deviation of the measurements by the square root of one minus the reliability coefficient (R).³

We developed a questionnaire to assess subject perception of the evaluation procedure. The content validity of the questionnaire was established following the evaluation of the instrument by several experts. The questionnaire was administered to each subject following the completion of the evaluation sequence.

RESULTS

Comparison of means for peak torque and total work obtained by the four examiners across test speed and muscle group are presented in Figures 1 and 2, respectively. ICCs and SEMs are presented in Table 2. ICCs calculated for peak torque ranged from .90 to .96 and .90 to .95 for total work. SEMs calculated for peak torque ranged from 8.9 to 13.3 Nm and 11.3 to 16.8 Nm for total work. Average student response scores from the questionnaire are presented in Table 3.

DISCUSSION

The interrater ICCs indicate that reliable isokinetic measures of peak torque and total work may be obtained by four examiners with a broad range of clinical and isokinetic experience. The estimates of reliability are consistent with the findings of researchers reporting intrarater reliability of isokinetic knee musculature assessment.^{8,9,11,12,18}

Karnofes et al⁷ examined the interrater reliability of isokinetic measures of ankle plantar flexion and dorsiflexion and reported reliability coefficients ranging from .82 to .95 in a sample of healthy adults (ages 20 to 75). Both examiners used







Fig 2. Comparison of examiner means for isokinetic measures of total work across test speed and muscle group (n = 16).

Table 2. Reliability Estimates for	Interrater Reliability of
Isokinetic Measures of the Knee	Musculature (SEM in Nm)

	Peak	Torque	Total Work			
	R	SEM	R	SEM		
Quadriceps		to part the second second	ang bailite	in the set		
60°/sec	.96	12.7	.95	16.0		
180°/sec	.90	13.3	.90	16.8		
Hamstrings						
60°/sec	.93	9.3	.95	12.0		
180°/sec	.91	8.9	.92	11.3		

Table 3. Results of Subjects Evaluation of Isokinetic Measurement Procedures

Statement	Average Response
 The warm-up was consistent between examiners. 	1.9*
The test instructions were consistent betwee examiners.	een 1.9*
3. The testing environment (ie, level of noise, activity) was similar for each of the tests.	1.6*
 My physical status did not change significantly between test sessions. 	1.9*
 The fourth test was easier than the first test Examiner A Examiner B Examiner C 	t. 2.9* 1.6‡ 1.3‡ 1.6‡
Examiner D	2.5‡

* For questions 1 to 5, subjects were asked to use the following scale:
1) Strongly agree, 2) Agree, 3) Neutral, 4) Disagree, and 5) Strongly disagree.

‡ For examiners A to D, subjects were asked to use the following scale:1) Expert, 2) Average, and 3) Beginner.

by Karnofes et al⁷ had no prior isokinetic testing experience, but each spent approximately 25 hours orienting to the test equipment and protocol. Although this amount of training time served to potentially improve interrater reliability of measures of ankle torque, the practice time may not be realistic in the clinical setting and limits the generalization to average clinicians or clinical departments in clinical settings. We believe that there were several factors contributing to the reliability of measures between the four examiners in our investigation.

The effect of a variety of isokinetic test parameters on muscle performance are well represented in the literature.^{1,4,5,6,10,17} Vari-

ations in testing procedures may result in alterations in muscle performance. Examples include: test speeds, subject position, stabilization, rest intervals, warm-up repetitions, use of visual feedback, and overall test sequence. Many of these factors can be controlled through the standardization of the test protocol. The high reliability suggests that the four examiners adhered closley to the standardized protocol.

Variations in subject position between examiners may result in inconsistent alignment between the axis of the subject's knee and the dynamometer. Differences in alignment may adversely impact measurement of torque production where the greater the difference is between the axis and the dynamometer, the larger the error.¹⁵

Positioning may also affect isokinetic measures of knee flexion and extension. Torque as a result of the relative position of the trunk and pelvis and the role of active and passive insufficiency of the muscle groups need to be considered. Bohannon et al¹ reported that knee peak and anglespecific flexion torque was significantly less when measured in the semireclined position than in the upright sitting position. There was no significant difference in peak and angle-specific extension torque between the two positions. However, terminal extension may be limited by passive tension of the hamstrings in individuals with anterior pelvic tilt or shortness of the hamstrings, potentially affecting work values.

Positioning of the subjects was initially completed by the first examiner. Appropriate information was recorded and saved as a component of the computer-stored subject test file. Positioning information was used by the subsequent examiners when obtaining retest measures. The Cybex isokinetic testing system provides the examiner with hardware reference points to facilitate recording of positional information when testing many muscle groups. However, positional information may be obtained with tape measures, goniometer, or other measuring instruments. Information must be recorded in an appropriate manner to allow consistency of positioning and joint axis alignment between examiners, minimizing the potential of measurement error between examiners or trials.

Another potential source of measurement error is inconsistency among examiners providing subject's test instructions. Confusion on the part of subjects may limit their ability to perform the desired tasks, in this instance, maximal voluntary contractions. Based on the results of the questionnaire, subjects reported agreement that the warm-up, test instructions, and test environment were consistent between examiners.

Consistency of communication between subjects and examiners may have been attributable to the working relationship within the same clinical department. Three of the examiners (A, B, and C) were graduates of the same educational program and had worked together for 2 years. Although examiner D is an experienced clinician, at the time of this investigation, D had worked in the department for 1 month. The recent change in clinical settings and unfamiliarity with the equipment may have contributed to the subjects rating D's isokinetic test abilities lower than that of examiners A, B, and C.

A final consideration with respect to population-specific reliability is that the subjects examined were healthy individuals with no past history of knee dysfunction. Generalization to individuals who vary from the characteristics of this group of subjects is therefore limited. Additional investigations examining interrater reliability of patient populations would be a practical addition to the clinical setting.

CONCLUSION

An understanding of the interrater reliability of isokinetic measures has important implications for testing procedures in clinical practice. This information may also assist in the evaluation of existing research data. The results of our investigation demonstrate that reliable measures of isokinetic muscle performance of knee extension and flexion may be obtained by four clinicians with varied clinical experience when following standardized measurement protocols.

REFERENCES

- Bohannon RW, Gajdosik RL, Leveau BF. Isokinetic knee flexion and extension torque in the upright and semireclined sitting position. *Phys Ther.* 1986;66:1083–1086.
- Delitto A, Strube MJ. Reliability in the clinical setting. Res Sect Newsletter: APTA. 1991;24:2–8.
- Denegar C, Ball D. Assessing reliability and precision of measurement: an introduction to intraclass correlation and standard error of measurement. *J Sports Rehabil.* 1993;2:35–42.
- Hagman PA, Gillaspie DM, Hill LD. Effects of speed and limb dominance on eccentric and concentric isokinetic testing of the knee. J Orthop Sports Phys Ther. 1988;10:59–65.
- Hald RD, Bottjen EJ. Effect of visual feedback on maximal and submaximal isokinetic test measurements of normal quadriceps and hamstrings. *J Orthop Sports Phys Ther.* 1987;9:86–93.
- Harding B, Black T, Bruulsema A, Maxwell B, Stratford P. Reliability of a reciprocol test protocol performed on the Kinetic Communicator: an isokinetic test of knee extensor and flexor strength. J Orthop Sports Phys Ther. 1988;10:218–223.
- Karnofel H, Wilkinson K, Lentell G. Reliability of isokinetic muscle testing at the ankle. J Orthop Sports Phys Ther. 1989;11:150–189.
- Kramer JF. Reliability of knee extensor and flexor torques during continuous concentric-eccentric cycles. Arch Phys Med Rehabil. 1990;71: 460–464.
- Kues JM, Rothstein JM, Lamb RL. Obtaining reliable measurements of knee extensor torque produced during maximal voluntary contractions: an experimental investigation. *Phys Ther.* 1992;72:492–501.
- Magnusson SP, Geismar RA, Gleim GW, Nicholas JA. The effect of stabilization on isokinetic knee extension and flexion torque production. *J Athl Train.* 1993;28:221–224.
- McCleary RW, Andersen JC. Test-retest reliability of reciprocal isokinetic knee extension and flexion peak torque measurements. J Athl Train. 1992;27:362–365.
- Perrin DH. Reliability of isokinetic measures. Athl Train, JNATA. 1986; 21:319–321.
- Portney LG, Watkins MP. Foundations of Clinical Research: Applications to Practice. Norwalk, CT: Appleton and Lange; 1993:53–67.
- Rothstein JM. Measurement in clinical practice: theory and application. In: Rothstein JM, ed. *Measurement in Physical Therapy*. New York, NY: Churchill Livingstone, Inc; 1985:5–15.
- Rothstein JM, Lamb RL, Mayhew TP. Clinical uses of isokinetic measurements. *Phys Ther*. 1987;67:1840–1844.
- Shrout PE, Fleiss JL. Intraclass correlations: uses in assessing rater reliability. *Psychol Bull*. 1979;86:420–428.
- Stratford PW, Bruulsema A, Maxwell B, Black T, Harding B. The effect of inter-trial rest interval on the assessment of isokinetic thigh muscle torque. J Orthop Sports Phys Ther. 1990;11:362–366.
- Tredinnick TJ, Duncan PW. Reliability of measurements of concentric and eccentric isokinetic loading. *Phys Ther.* 1988;68:656–659.

A Review of Selected Blood-Borne Pathogen Position Statements and Federal Regulations

Brent L. Arnold, PhD, ATC

ABSTRACT: One response to the AIDS epidemic has been the formation of blood-borne pathogen policy statements by medical associations, athletic governing bodies, and the federal government. The policy statements by medical associations and athletic governing bodies discuss a wide range of issues, including the eligibility of infected athletes and the right of infected health care workers to practice. In contrast, federal regulations are limited to employees in the work environment. Despite the apparent comprehensiveness of these documents, major deficiencies in the documents do exist. For example, employees exposed to body fluids are entitled to free, employ-

In recent years, the AIDS crisis has forced the health care professions to reassess many patient care procedures. This reassessment has ranged from regulations on handling biohazardous materials to concerns about patient confidentiality. One of the results of these reassessments has been to formulate policy statements by various health care organizations.¹⁻⁴ Naturally, these reassessments have had a direct impact on athletics and athletic health care. Thus, various athletic governing bodies and associations have issued statements^{5,9,11,12} advising athletics personnel, including athletic trainers, on how to deal with various issues associated with AIDS in the athletic setting. These statements address issues similar to those listed above, as well as issues more specifically related to athletics, eg, athletic eligibility.

The purpose of this paper is to compare and contrast the various statements issued by health care professions, the health care industry, and athletic governing bodies. This will allow clinicians to have a better perspective on the complexity of the practical and philosophical issues associated with AIDS in both the general health care and the athletic health care settings. Additionally, I hope to provide a foundation from which athletic trainers can begin to review their own procedures and policies for dealing with HIV-infected individuals.

THE RIGHTS OF THE INFECTED INDIVIDUAL

One of the primary issues associated with the AIDS epidemic concerns the rights of the infected individual. One right of particular interest to those in athletics is the right of infected athletes to participate. According to the American Academy of Pediatrics (AAP),¹ "involuntary restriction of an infected athlete is not justified" based on the absence of proven risk of

Brent L. Arnold is an assistant professor and Graduate Coordinator of Athletic Training at West Virginia University in Morgantown, WV 26506-6116.

er-provided HIV testing. Similarly, athletes exposed to body fluids also are entitled to voluntary HIV testing. However, it is unclear who should pay for this testing. Furthermore, AIDS testing of student athletic trainers is never discussed. Although there are deficiencies, these documents provide guidelines for resolving the deficiencies. For example, because student athletic trainers act as employees of their institution, it is reasonable to suggest that they receive the same protections that federal regulations provide to employees. Thus, the athletic trainer should find these documents useful for developing policies related to blood-borne pathogens.

infection during athletic competition, and "athletes infected with HIV should be allowed to participate in all competitive sports." The National Federation of State High School Associations¹² states, "competitions... should not be restricted because a known HIV-infected athlete happens to be a team member (of an opposing team)." Additionally, the National Collegiate Athletic Association (NCAA)⁵ states the decision for an infected athlete to continue participation "should involve the student-athlete, the student-athlete's personal physician, and the team physician." The NCAA suggests that factors to be considered in this decision include the current health status, the current HIV status, and the nature and intensity of the athlete's training.⁵

In addition to the right of the infected athlete to participate, there is the question of whether the infected health care worker has the right to practice. Several of the position statements discuss the roles of infected health care workers in patient care. The American Medical Association (AMA)³ states that infected health care workers should be evaluated by their physicians to determine whether they can perform invasive procedures safely. The American Osteopathic Association⁴ "affirms the right of HIV-infected individuals to practice their occupations in a manner that does not present an identifiable risk of transmission of disease and pledges to promote the ability of these individuals to continue productive careers so long as they can do so responsibly and safely." The State of Michigan¹⁰ recommends that infected workers should seek medical care and periodic evaluation. Additionally, a Michigan worker must inform his/her physician or health care facility "when there is significant risk of compromised patient care."10

PATIENT AND EMPLOYEE/HEALTH CARE WORKER EDUCATION

Patient education specifically refers to the education of infected individuals or individuals at risk of infection (eg, athletes/participants). The United States Olympic Committee (USOC)⁹ states "Educational information including activities that place individuals at high risk because of lifestyle, geographic location, or a specific sport should be made available to participants and those deemed at risk associated with the athlete/athletic event (eg, manager, coaches)." The AAP's position¹ applies more to the infected athlete. It argues that a physician should inform a known HIV-infected athlete who participates in sports involving blood exposures (eg, football and wrestling) of the "theoretical risk" of infecting others and "encourage him to consider another sport." Additionally, the AAP¹ supports educating athletes of the danger of sharing needles for illicit drug use, including steroids.

With regard to employee education, the AAP's statement¹ has the greatest direct relevance to the athletic setting. It advocates that, "Each coach and athletic trainer should receive training in first aid and emergency care and be provided with the necessary supplies to treat open wounds." The American Osteopathic Association⁴ similarly "endorses programs for effective education and implementation of universal precautions in all health care settings." The AMA³ adds an additional dimension by stating that medical training programs (eg, athletic training education programs) should include basic science training, clinical science training, ethical issues training, and social issues training as they relate to HIV infection. The AMA also believes that there should be instruction in techniques to minimize the risk of acquiring HIV and support systems for students coping with the difficulties associated with HIV infection.

The Centers for Disease Control $(CDC)^7$ state that health care workers should receive training in infection control in professional schools and receive continuing education updates. Federal law¹³ supports the CDC's suggestion of continuing education by requiring employers to retrain employees whenever there are changes to current procedures. Federal regulations require that the dates of training sessions, the content of training sessions, the names and qualifications of persons conducting the training, and the names and job titles of those receiving training be maintained for 3 years after the training session.

MEDICAL RECORDS AND CONFIDENTIALITY

One of the greatest concerns to any health care professional is the maintenance of confidential records. This is particularly important in athletics due to the public nature of the activity. The AAP¹ provides the clearest statement regarding medical records and medical record confidentiality: "The physician should respect an HIV-infected athlete's right to confidentiality. This includes not disclosing the patient's status of infection to the participants or the staff of athletic programs." Additionally, the American College Health Association² states that "the inclusion of any information regarding HIV infection in the medical record should be discussed with the patient before its entry." The NCAA⁵ supports these positions and states "only those persons in whom the infected student chooses to confide" have the right to know the athlete's HIV status. In contrast to the American College Health Association position, federal regulations¹³ specifically state that records must be kept for employees. However, these regulations restrict what can be included in the record. The regulations¹³ state that the health care professional's "written opinion" should contain only information stating that the employee has been informed of the results of postexposure evaluation and has been told of medical conditions resulting from exposure which require further evaluation. The records must contain:

- 1. the employee's name and social security number,
- 2. a copy of the employee's hepatitis B virus (HBV) vaccination status including dates of vaccinations,
- 3. a copy of the results of all medical examinations resulting from exposures,
- 4. a copy of the health care professional's written opinion, and
- 5. a copy of information required to be provided to the professional health care worker.

The records must be kept confidential and not disclosed to any person without written permission from the employee except as otherwise required by law.

HEALTH INSURANCE

Often overlooked in the process of dealing with blood-borne pathogens is health insurance. It is likely that many health care practitioners are unaware of whether their personal health insurance covers medical care for AIDS.

The AMA is the only organization to deal with insurance coverage in a detailed fashion. The AMA³ encourages health care workers to assess their needs and select disability insurance which includes AIDS coverage and provides an "ownoccupation clause, guaranteed renewability, future insurability, and partial disability provisions." Additionally, the AMA believes all health care training programs should provide insurance options to students which include the above clauses, and believes enrollment should be mandatory.

HIV TESTING

One of the potentially more controversial policies which may be developed by an institution is to require HIV testing of health care workers. Those position statements that discussed testing for AIDS^{1-5,9,12} agreed that it should be strictly voluntary. The state of Michigan¹⁰ specifically states that testing of health care workers is "not recommended nor should it be a requirement for employment." However, the AMA³ states that in cases of documented exposure to HIV "employers ... should provide, at the employer's expense, serologic testing to the health care worker who has been exposed." Federal regulations¹³ support this position by stating that the exposed employee's and source individual's blood is to be collected and tested after consent is obtained. If an individual's consent cannot be obtained, "the employer shall establish that legally required consent cannot be obtained," and no testing should be performed on that individual. After testing, the results must be made available to the exposed employee along with information about applicable laws pertaining to disclosure of the source individual's identity and infectious status. However, federal law only applies to employees and does not cover student athletes, student athletic trainers, or other student help.

As with health care worker testing, all of the position statements which discussed patient and athlete testing^{1-5,9,12} state such testing should be voluntary. According to the AAP,¹ "Routine testing of athletes for HIV infection is not indicated," but the USOC⁹ suggests that voluntary testing should be available to athletes who are perceived as being at risk. The NCAA⁵ states that mandatory testing is not recommended, but individuals desiring testing "should be assisted in obtaining such services by appropriate campus or public health officials." Finally, the AMA³ suggests that physicians should encourage patients who are at known risk of HIV or HBV to be tested.

COUNSELING

Closely related to testing is counseling. The AMA position³ offers the most comprehensive discussion of HIV counseling. It suggests counseling should be provided before and after HIV testing, and that the post-test counseling should be conducted regardless of whether the test results are positive or negative. Additionally, the meaning of negative results (ie, false negatives) should be explained, and the meaning of positive results should be explained in a "confidential face-to-face session." The NCAA⁵ and the USOC⁹ add that counseling should be provided whenever athletes are exposed to blood or wounds. According to both documents, this counseling should be provided to the wounded athlete as well as to the exposed athlete.

EXPOSURE PREVENTION

Preventing exposure is one of the most important and broadest areas related to blood-borne pathogens. It includes measures in three general areas: 1) protecting patients and health professionals during health care services, 2) protecting various individuals in the athletic setting, and 3) maintaining a safe environment.

Protecting Against Exposure During Health Care Services

Athletic health care is provided in the training room as well as in the field. Thus, where appropriate, I have discussed both environments.

Wounds and Bleeding. One of the greatest concerns is how to protect the patient and the health care worker when one or the other is wounded or bleeding. It is generally agreed that health care workers with "occupationally transmissible infections, exudative lesions, or weeping dermatitis should not be involved with direct patient contact until the condition resolves."³ The State of Michigan¹⁰ differs slightly by saying that only invasive procedures and handling equipment used in invasive procedures should be avoided. The CDC⁷ supports the AMA position³ by stating that health care workers with "exudative lesions or weeping dermatitis, particularly on the hands, should refrain from all direct patient care and from handling [instruments] until the condition resolves."

For athletes, the NCAA^{5,11} and the USOC⁹ agree that open lesions, wounds, dermatitis, etc should be covered with dressings that prevent contamination from other sources. The NCAA⁵ states that existing wounds should be covered with "an occlusive dressing that will withstand the demands of competition" before athletic participation. According to the USOC,9 if an athlete is wounded and large amounts of blood are present during the course of competition, the competition should be stopped to allow the wound to be covered and to allow the playing area to be cleaned. The NCAA¹¹ agrees; "whenever an athletic participant suffers a laceration or wound where oozing or bleeding occurs, the practice or game should be stopped at the earliest possible time, and the player should leave the field of play and be given appropriate medical treatment." Furthermore, uniforms "saturated with blood" must be "evaluated by appropriate medical personnel for potential infectivity and changed if necessary before return to participation."5

Hand Care and Protection. Hand care includes the use of gloves and hand washing. The USOC statement⁹ represents not only the general consensus of the statements which discuss glove usage but also applies directly to the athletic setting: "Gloves should be worn when contact with blood or other body fluids is anticipated. Gloves also should be worn for touching mucous membranes or nonintact skin (eg, abrasion, dermatitis) of all athletes and for handling items or surfaces soiled with blood or body fluids. Gloves should be changed after contact with each athlete."

The NCAA⁵ adds that the gloves used in the treatment of wounds should be sterile. Finally, in the event of an emergency the AAP¹ suggests that heavy toweling may be used until an "off-the-field" setting can be reached and gloves obtained.

The CDC^7 also requires the use of gloves when treating patients and the use of sterile gloves for surgical procedures. It also states that gloves should not be washed before use to prevent "wicking" of body fluids through undetected holes in the gloves and that damaged gloves "should be removed as soon as patient safety permits." Finally, the CDC indicates that gloves should be disposed of—not reused.

According to OSHA regulations,¹³ the employer must ensure that protective equipment (eg, gloves) is used. However, the employer is excused from this requirement if they can demonstrate that "under rare and extraordinary circumstances, it was the employee's professional judgment . . . [that the use of gloves] would have prevented the delivery of health care . . . or would have posed an increased hazard to the safety of the worker or co-worker."¹³

In addition to wearing gloves, hand washing is considered an important method of reducing the chances of exposure. The AAP's statement¹ on hand washing is the most detailed and agrees with other statements discussing hand washing. It states that any skin exposed to blood or other body fluids should be washed with soap and warm water "as soon as is practical." If soap and water are not available, alcohol or other skin antiseptics may be used. Furthermore, hands should always be washed after each glove removal.

The CDC⁷ supports the AAP's position¹ indicating that hands should be washed "before and after each patient (ie, before glove placement and after glove removal)" and after bare-handed touching of potentially contaminated inanimate objects. Furthermore, the CDC⁷ states that plain soap and water are adequate for procedures other than surgical procedures.

According to OSHA,¹³ the employer "shall provide handwashing facilities which are readily accessible to employees." If hand-washing facilities cannot be made available, the employer must provide clean paper towels and antiseptic hand cleaner or antiseptic towelettes.

Sharps. Another concern in the clinical setting is the use and handling of sharp objects (sharps) such as scalpels, and, especially, needles. According to the NCAA,⁵ needles should be disposed of in puncture-resistant containers and not recapped or broken by hand. The CDC⁷ suggests needles may be recapped, but "needles should never be recapped or otherwise manipulated using both hands, or any other technique that involves directing the point of a needle toward any part of the body." If needles must be recapped, the CDC advocates using mechanical devices or the one-handed "scoop" technique. Furthermore, the CDC does not recommend bending or breaking needles. OSHA¹³ agrees with the CDC on bending needles but is more restrictive on recapping needles. Federal law permits recapping only when "the employer can demonstrate that no alternative is feasible or that such action is required by a specific medical procedure." If recapping is necessary, the regulations state that a mechanical device or a one-handed technique should be used.

Vaccines. OSHA¹³ requires employers to make hepatitis B vaccinations available free of charge, and the CDC⁷ recommends that all health care workers at risk of exposure be vaccinated for HBV.

Exposure Prevention in the Athletic Setting

The risk of exposure is not limited to the medical setting. Blood exposure and exposure to other body fluids is a common occurrence in athletics. Thus, it is important to consider methods of limiting exposure in the athletic environment. Because the procedures outlined above should provide adequate protection for the health care worker regardless of setting, this section will focus on methods designed to protect other individuals in the athletic setting.

The Athlete. Three of the documents^{5,9,11} have made suggestions regarding methods of protecting the athlete from exposure to blood-borne pathogens.

Mouthpieces. One of the suggestions for protecting athletes requires the use of mouthpieces. Specifically, the USOC⁹ supports required usage of mouthpieces in high risk sports (eg, wrestling and boxing) and strongly recommends mouthpieces for moderate risk sports (eg, basketball, field hockey, ice hockey, and soccer).

Spittoons. Only the USOC⁹ discusses the issue of spittoons. It states that vessels for bloody sputum or saliva should contain a substance that inactivates HIV and HBV.

Showering. The USOC⁹ recommends that all athletes shower immediately after competitions.

Vaccines. In addition to the above physical precautions, the USOC⁹ suggests that athletes who are exposed to HIV or HBV be evaluated for immunization against HBV. The American College Health Association² states that persons infected with HIV should be vaccinated for measles and rubella.

Referees. Only the USOC⁹ has made suggestions on how to protect referees from exposure. Specifically, the USOC recommends that officials in the highest risk sports (eg, boxing, wrestling) wear eye protection.

General Environmental Protections

Closely related to protection in both the medical and athletic settings are general environmental protections. Specifically, these protections relate to how the working environment (both clinical and athletic) are kept clean.

Surfaces. One of the most obvious concerns in keeping a clean environment is maintaining clean work and playing surfaces. The USOC⁹ states that contaminated surfaces should be cleaned with a solution known to inactivate the virus after each match and more often, if necessary. Federal regulations¹³ require surfaces to be cleaned and decontaminated with an appropriate disinfectant after each contact with blood or potentially infectious materials.

The NCAA¹¹ makes no mention of how often surfaces should be cleaned but states that a 1:100 dilution of bleach or an Environmental Protection Agency-approved germicide should be used. The AAP¹ agrees with the NCAA and states that contaminated surfaces "... should be cleaned with fresh household bleach solution made for immediate use as follows: 1 part bleach to 100 parts water, or 1 tablespoon bleach to 1 quart water.... " The CDC⁷ supports the use of the bleach mixture proposed by the AAP¹ and the NCAA¹¹ but more narrowly defines germicides as those labeled for tuberculocidal activity, including phenolics, iodophors, and chlorinecontaining compounds. Additionally, the CDC⁷ indicates that surfaces should be cleaned with disposable toweling and an "appropriate cleaning agent and water" and that imperviousbacked paper, aluminum foil, or plastic covers should be used to protect items and surfaces "that are difficult or impossible to clean and disinfect."

Soiled Linen. In addition to contaminated surfaces, the athletic trainer frequently has to deal with soiled linen. The USOC⁹ recommends that soiled linen be bagged, tagged, and washed in hot water with a detergent known to deactivate HIV. Additionally, it is recommended that disposable toweling be used in place of linen toweling whenever possible.

According to OSHA regulations,¹³ soiled linen is to be transported in red containers/bags or containers/bags labeled with the biohazard warning label. If the laundry is wet, the bags or containers should be made of materials that prevent soaking or leakage of contaminants through the container. Finally, employees handling the contaminated laundry are required to wear gloves and other appropriate protective equipment.

POSTEXPOSURE PROCEDURES

Following an exposure, certain procedures must or should be followed.

Exposure Documentation

The USOC statement⁹ is the only source to directly refer to the documentation of exposures in the athletic setting. It states, "If an exposure occurs, the circumstances should be recorded in a confidential medical record (date, time, details of exposure, source of exposure)." This is supported by federal regulations¹³ which state that the employer shall document the route of exposure, the circumstances of exposure, and the identity of the source individual (unless infeasible or prevented by local law).

Notification

The AMA³ supports the ethical obligation of a health care worker to notify his/her patient of the patient's exposure to HIV. Michigan's recommendations¹⁰ are more specific and state that the patient should be notified any time he/she is exposed to the health care worker's body fluids. The USOC⁹ recommends that the source individual of an exposure be notified of an exposure and be asked to give consent for HIV testing. Federal law¹³ does not require an exposed individual to be notified of an exposure, because it assumes the exposed individual will know that he/she has been exposed.

DISCUSSION

One of the difficulties with any position statement is that it is always at risk of being rapidly outdated due to changes in the current state of understanding. For example, all position statements were written before the documentation of two cases of casual transmission of HIV.^{6,8} Thus, some re-examination of these policies may be necessary. Specifically, because casual transmission is possible, should infected athletes continue to have the right to participate in athletics?

In an editorial that followed the Fitzgibbon et al⁸ case study, Simonds and Rodgers¹⁴ stated that, because the risk of transmission is low in the homes, schools, and day-care centers, "HIV-infected children should not be excluded solely on the basis of their infection." However, because athletic competition includes frequent blood and body fluid exposures, it is reasonable to argue that the athletic environment is not a typical environment. This increased risk in the athletic environment may constitute an additional basis by which infected athletes could or should be excluded from participation.

Regardless of whether infected individuals are allowed to participate, it is clear that education is a necessary part of the prevention of blood-borne pathogen transmission. As indicated previously, educating employees is mandated by federal regulations.¹³ However, there are no regulations regarding the education of athletes or student athletic trainers. With regard to athletes, the position statements of the USOC⁹ and the AAP¹ clearly suggest that the athlete is entitled to some form of basic

education relating to blood-borne pathogens. It seems reasonable to suggest that blood-borne pathogen training should be part of freshman orientation for all college and high school athletes. This orientation should also involve the high school athlete's parents. Furthermore, based on the federal requirement¹³ to provide periodic retraining of employees, it seems reasonable that periodic reviews should be provided for athletes.

For student athletic trainers, the need for appropriate bloodborne pathogen training is even greater. As suggested by the AMA,³ athletic trainer education should include training in basic and clinical sciences related to blood-borne pathogens. This training should be provided in both internship and accredited athletic training education programs.

One of the unique aspects of the practice of athletic training is that the athletic trainer often knows a great deal about an athlete's health status before injury. One exception to this may be an athlete's HIV status. Three of the position statements^{1,2,5} indicate that the athletic trainer has no right to know if an athlete is HIV-positive unless the athlete chooses to inform the athletic trainer. This would appear to place the athletic trainer at increased risk of exposure. However, the athletic trainer should not be at increased risk of exposure if he or she follows universal precautions when dealing with all athletes.

Closely related to the issue of an athletic trainer's right to know an athlete's HIV status is the obligation to keep this information confidential. If the infected athlete chooses to inform the athletic trainer of his or her HIV status, the athletic trainer must keep the information confidential. This includes not disclosing the HIV status to student athletic trainers, coaches, or other team personnel without the athlete's permission.

In addition to not having to disclose his or her HIV status, the athlete is not required to submit to HIV testing. However, based on the position statements of the USOC⁹ and the NCAA,¹¹ voluntary testing should be provided to the athlete upon request. Additionally, it seems reasonable to extend these privileges to student athletic trainers as well.

Perhaps the more important question regarding HIV testing is who is responsible for the cost of testing. In the case of the professional athlete, he or she should be covered by federal law, and, thus, the employer should pay. For the collegiate athlete, all medical expenses related to athletics are covered by the institution. Therefore, it is reasonable to argue that any necessary HIV testing due to an exposure resulting from athletic participation should be paid for by the institution. In contrast to the collegiate athlete, the health care of collegiate student athletic trainers generally is not covered by the institution. Thus, the argument for providing them with free HIV testing is not as compelling. However, these individuals, while not employees, do act as agents of the institutions for which they work. Therefore, an ethical argument can be made supporting the right of these individuals to receive free HIV testing after an exposure resulting from their athletic training duties.

Exposure prevention may be the most important element of the position statements. Almost all of the position statements discussed exposure prevention in one form or another. In all of these cases, the position statements were in agreement with the universal precautions set forth by the CDC⁷ and federal law.¹³ Thus, it is clear that, in the athletic environment, universal precautions are the standard to be followed when providing patient care.

As part of the exposure prevention and control procedures mandated by the federal government,¹³ employers are required to provide HBV vaccinations to all employees at risk of exposure. However, as indicated previously, these regulations apply only to employees and provide no protection for nonemployees. As with HIV testing, the question of who should provide HBV vaccinations to athletes and student athletic trainers arises. As stated above, the collegiate athlete's medical services are provided by the athletic institution. Thus, it is reasonable to expect that an athlete who is identified as being at risk of exposure through athletics should be provided with the HBV vaccination as part of the standard medical coverage provided to athletes. For the student athletic trainer who provides health care service to athletes or patients, it is clear that a vaccination for HBV should be required. The question as to who should pay for the vaccination remains, however. Because student athletic trainers are acting as agents of the institutions for which they work, an ethical argument can be made that the institution for which they work should provide the vaccination. In situations where the student athletic trainer is enrolled in one institution but is providing services to another institution or organization, it seems reasonable that the institution or organization receiving the greatest benefit from those services should provide the HBV vaccination.

In summary, the issues associated with blood-borne pathogen policies are multifaceted. This is particularly true in athletics due to the wide variety of employment settings and the variety of personnel associated with the various settings. However, it is clear that all athletic trainers must adhere to OSHA regulations in those situations in which the regulations directly apply. Additionally, for situations in which the federal regulations do not directly apply (eg, student athletic trainer vaccinations), the athletic trainer should use those regulations and the position statements of the other health care professions as models for resolving the discrepancies.

ACKNOWLEDGMENTS

I would like to thank David H. Perrin, PhD, ATC, at the University of Virginia for his support of this project.

REFERENCES

- American Academy of Pediatrics. Human immunodeficiency virus [acquired immunodeficiency syndrome (AIDS) virus] in the athletic setting. *Pediatrics*. 1991;88:640–641.
- American College Health Association. *General Statement on Institutional Response to Aids*. Rockville, MD: Task Force on Aids, American College Health Association; 1988;1–6.
- American Medical Association Department of HIV, Division of Health Science. *Digest of HIV/AIDS Policy*. Chicago, IL: Department of HIV, American Medical Association; 1993:1–15.
- 4. American Osteopathic Association Position on HIV. Triad. 1992;4:31-32.
- Benson MT, ed. Guideline 2H: blood-borne pathogens and intercollegiate athletics. NCAA Sports Medicine Handbook. Overland Park, KS: NCAA; 1993:24–28.
- Brownstein A, Fricke W. HIV Transmission between two adolescent brothers with hemophilia. MMWR. 1993;42:948–951.
- Centers for Disease Control and Prevention. Recommended infectioncontrol practices for dentistry. MMWR. 1993;42(No RR-8).
- Fitzgibbon JE, Gaur S, Frenkel LD, Laraque F, Edlin BR, Dubin DT. Transmission from one child to another of human immunodeficiency virus type 1 with a zidovudine-resistance mutation. *N Engl J Med.* 1993;329: 1835–1841.
- Garl T, Hrisomalos T, Rink L. Transmission of Infectious Agents During Athletic Competition. Colorado Springs, CO: United States Olympic Committee; 1991:1–24.
- Michigan Department of Public Health. Michigan recommendations on HBV-and/or HIV-infected health care workers. *Triad*. 1992;4:32–34.
- National Collegiate Athletic Association. Blood on Uniforms, Skin, Equipment, and Surfaces. Memorandum to Directors of Athletics and Head Athletics Trainers of NCAA Institutions. Overland Park, KS: National Collegiate Athletic Association; 1992.
- National Federation of State High School Associations, National Federation Target Program. *Letter to Membership*. Kansas City, MO: National Federation of State High School Associations; 1993.
- Occupational Safety and Health Act, 29 USC 655, 657. Federal Reg. 1991;56:64175-64182.
- Simonds RJ, Rodgers MF. HIV prevention—Bringing the message home. N Engl J Med. 1993;329:1883–1885.

Join Pro Sports Teams & World Class Athletes Using These Challenging & Inexpensive Tools!

Medicine Balls

For strengthening & proprioception Med-Balls: Large balls that bounce. 1, 2 & 3kg \$20-\$50 Heavy Meds: 1/2, 1, 2 & 3kg \$10-\$30 Training Bowls: Built in soft handles. 1 to 12 lbs. \$35/pair

Massage Balls

Sensy Balls: Great for massage! 10cm, 20cm & 28cm. \$9-\$15

Movin'Sit: Inflatable wedge shaped cushion. Dynamics of a ball while sitting on a chair. Use as a seat or back support. \$30

AIR PUMPS & MATS AVAILABLE



Gymnic Ball: Inflatable vinyl balls. Support up to 660lbs. Sizes from 1 to 6 ft in diameter. \$10-\$200

Best Prices in the USA! Call 1-800-PLA-BALL

Professional Pricing Available / 6+Balls = Free Shipping & Handling

Videos

Orthopedic Spts Med & Fitness Applications Using the Swiss Ball \$100 Spinal Stabilization Utilizing the Swiss Ball \$70 Functional Kinetis Using the Swiss Ball \$65 FitBall-Aerobics & Conditioning A

safe, fun & easily modified workout for people of most abilities and all ages. \$30

Books

New Dance Medicine Manual \$20 New Golf Improvement Program \$17 Exercises with the Ball \$20 FitBall Manual \$10

Ball Dynamics

INTERNATIONAL¥

A Unique Way To

Honor A Friend!

Making a contribution to the NATA Research & Education Foundation (the Foundation) in memory or in honor of a special friend or family member is a unique way to make a charitable donation. Once you have sent your gift to the Foundation, an acknowledgment is sent to the friend, family member or anyone else you indicate. This is a great way to say Happy Birthday! or Congratulations! and save a trip to Hallmark. It is also a meaningful way to commemorate a loved one who has passed away. For more information, please call Briana Ebmeier, Foundation manager, at 800-TRY-NATA, extension 142.



T ip from the Field

Taping the Hammer Toe

Benjamin H. Reuter, MSEd, ATC, CSCS

Hammer toe is a condition in which the distal interphalangeal joint and metatarsal phalangeal joint become flexed or hyperflexed, and the proximal interphalangeal joint becomes hyperextended.³ The condition usually afflicts the second toe, but can occur with any toe.²⁻⁴ Causes include shoes that are too short in the toe box and congenital factors, such as muscle contractures.¹ The condition may place stress on the nail¹ and can cause callouses or corns on the joints or tip of the affected toe.³ Severe cases of hammer toe require surgery. In less severe cases, taping may relieve the irritation and permit the sufferer to participate in athletics.²

A 17-year-old male basketball player's hammer toe recently led to the development of a taping technique that may be useful in relieving the condition in other athletes. The basketball player ruptured his right extensor hallucis longus tendon in an all-terrain vehicle accident. He could not actively extend the distal interphalangeal joint; however, passive extension was possible. Putting weight on the great toe placed the tip of the distal phalanx in contact with the insole of his shoe. The results of this constant pressure were blisters and callouses. To provide adequate protection, I developed a taping technique that enabled the athlete to complete the season with minimal discomfort. A description of the technique follows.

Step 1

Place the ankle in plantar flexion. Spray the toe, foot, and ankle with tape adherent. Apply heel and lace pads to the anterior ankle and Achilles tendon area, and cover the foot with prewrap (Fig 1).

Step 2

Pull the affected toe into passive extension by applying a sling of 1-inch Elastikon (Johnson & Johnson, Raynham, MA) to the ball of the affected toe. Cross the tape over the instep of the foot and anchor the tape ends to the Achilles tendon area over the heel and the lace pad (Fig 2). Repeat the procedure two to three times (Fig 3).



Fig 2. Application of an Elastikon tape sling to pull the DIP joint of a hammer toe into passive extension.



Fig 1. Proper positioning and preparation of the extremity for hammer-toe taping.

Benjamin H. Reuter is an athletic trainer at Greater Atlanta Sports Medicine in Atlanta, GA 30327.



Fig 3. Application of additional Elastikon tape slings to pull the DIP joint of a hammer toe into passive extension.



Fig 4. Example of a completed hammer toe tape job.

Step 3

Anchor the slings over the instep of the foot and ankle by applying circular strips of 2-inch Conform (Bike Athletic Co, Knoxville, TN), locking the Conform with 1-1/2-inch athletic tape (Fig 4).

An athletic trainer needs to practice this technique to develop the skill to ensure that the tape does not constrict circulation or overly restrict movement. The athlete was able to complete the basketball season with his toe taped this way. He does plan to undergo surgery to attempt to repair the ruptured tendon, although the operation has not yet been scheduled.

REFERENCES

- American Academy of Orthopaedic Surgeons. *Athletic Training and* Sports Medicine. 2nd ed. Park Ridge, IL: American Academy of Orthopedic Surgeons; 1991:434.
- 2. Arnheim DD, Prentice WE. *Modern Principles of Athletic Training*. 8th ed. St. Louis, MO: Mosby Year Book, Inc; 1993:478.
- Cailliet R. Foot and Ankle Pain. 2nd ed. Philadelphia, PA: FA Davis Company; 1989:135–138.
- 4. Hopenfeld S. *Physical Examination of the Spine and Extremities*. East Norwalk, CT: Appleton-Century-Crofts; 1976:220.

Balance and Fitness for Life



Dynamic Hand Strengthening and Rehab,

- ▶ unlimited applications
- ► 5 color coded resistance levels

Adjustable Height Wobble Boards, ▶ exceptional quality ▶ available in 3 sizes

To Learn More Call:

1-800-Fitter-1

(348-8371)

Fitte

Pro

AU12V2



Pro Fitter Offers:

- ► 26 functional exercises for upper and lower body training
- ▶ six tension levels
- easy setup, low maintenance
- quiet, lightweight, durable

Fitter Products improve strength and endurance while improving the functional areas of balance, co-ordination, timing and overall body



FITTER INT'L. INC. 4515 1 St. SE, Calgary, AB. Canada T2G 2L2 ph: (403) 243-6830 Fx: (403) 229-1230

T ip from the Field

An Electronic Daily Injury Report System Richard Ray, EdD, ATC

The use of personal computers by athletic trainers has grown steadily since 1982, when their application for athletic training was first described.¹ I have been suggesting since then that athletic trainers could streamline many different administrative functions through computerization.⁴ Athletic trainers in every setting are using computerized injury and treatment databases,³ insurance and word processing,^{5,6} budget and inventory tracking,⁴ and electronic communications² to improve their administrative efficiency. The purpose of this paper is to inform athletic trainers of an additional and heretofore unreported use for the computer—an electronically produced daily injury report delivered via electronic mail (e-mail).

Like many other athletic trainers, I am committed to maintaining excellent communication between the athletic training and coaching staffs. Unfortunately, the production of the daily injury report for our 18 intercollegiate teams diverted too much time from important patient-care responsibilities. In addition, my college president issued a request that all employees consider developing ways to reduce paper communications. He specifically asked that we consider the increased use of e-mail. I have reduced the time spent producing, copying, and delivering daily injury reports from 1 hour to approximately 10 minutes per day since instituting our electronic mail system. In addition, this system has reduced the amount of paper used by more than half. Most importantly, the e-mail report system has improved the quality and convenience of communication between the athletic training and coaching staffs.

SYSTEM COMPONENTS AND OPERATION

The electronic injury report system I use is possible because all coaches at my institution have either a personal computer (PC) or a terminal on their desks. Each of these devices is hardwired to the college's VAX mainframe computer. The electronic injury report system combines two software applications to deliver a custom-produced, up-to-date injury report to each coach's desk by 11 AM each day. WordPerfect 5.1 (WordPerfect Corporation, Orem, UT) is used to produce the reports and Kermit (Columbia University, New York, NY) is used to distribute them via e-mail.

Richard Ray is Head Athletic Trainer and an associate professor of Physical Education at Hope College in Holland, MI 49423.

PRODUCING THE REPORTS

In order to streamline the production of the daily injury reports, the college's computer center produced two WordPerfect macros. A macro is a simple program designed to save keystrokes by executing several commands at the stroke of one or two keys. I simply have to type Alt-R on my office PC and a list of all the intercollegiate sports we sponsor appears on the screen. To select a sport, I move the cursor to the sport and press the ENTER key. This action will bring up yesterday's report for that sport. Next, I use WordPerfect's editing tools to update the report (see Figure).

I type Alt-S after the report has been edited to invoke another macro. This macro performs three functions. First, it prints a copy of the report on my printer. I keep a paper copy of each report to dictate injury evaluation reports for the students' health service files. Next, the macro saves a copy of the report to the directory on my PC's hard drive, which contains all the previous reports for that particular sport. Although I don't use these reports to generate end-of-season summaries (I use other software for this purpose), hard disk storage allows me to locate a particular athlete's injury quickly and easily. Finally, the macro produces an ASCII file (a generic text file without the word processing codes) and saves the file to a directory that the Kermit program will use when finding and distributing the report.

DISTRIBUTING THE REPORTS

After the reports for each sport have been produced and saved, I exit WordPerfect and activate a macro written in Kermit, a popular communications software program. This macro accomplishes several tasks automatically. First, it logs my PC onto the college's VAX mainframe computer. Next, it searches for any files in the directory on my PC hard drive where WordPerfect stored the reports in ASCII format. Kermit then sends each injury report as an e-mail message to each of the coaches on that sport's e-mail distribution list. Each distribution list contains the e-mail addresses of the coaches for a particular sport. Football coaches receive only the football report, soccer coaches receive only the soccer reports, and so on. This process takes about 45 seconds to distribute 10 reports to 15 coaches. I have included my e-mail address on each of the distribution lists as well. By sending myself a copy of each report, I can monitor any malfunctions in the system.

FOOTBALL

SPORT:

NAME	INJURY	DATE INJURED	DATE REPORTED	COMMENTS	
Black, Chad	R-hamst strain	8-20-91	8-20-91	treatment, rest	
Green, Tim	L-5th finger fx.	8-20-91	8-20-91	taping	
Blue, Tom	L-quad strain	8-20-91	8-20-91	treatment, rest	
NO PARTICIPATION	GO AS	ABLE	NO LIMI	TATIONS	REMOVED FROM LIST
Brown, Roger Purple Black, Jim Pink, Yellow, Walter Black, Chad		e, Andy Andrew	Green,	Tim	Orange, Wally
Red, Brian					

Injury report, after editing, generated by WordPerfect 5.1 macro.

EDUCATING COACHES

Almost all of the coaches have found the electronic injury report system to be informative and easy to use. A concern that I had before launching this program was that coaches might exhibit resistance to the new technology. To prevent this problem, I invested a significant amount of time and energy educating each coach about how to use e-mail. I met with each coach individually to explain the system. I produced and affixed a small laminated instruction card to each coach's computer. For the first few days of each coach's season, I put a written note in their mailboxes to remind them to check their e-mail at 11 AM for their daily injury report. After about 1 week, nearly all the coaches were using the system on a daily basis to review their athletes' health status. Many were even using the REPLY feature on our VAX e-mail system to send me questions they had regarding the status of athletes on their team.

CONCLUSION

I strongly recommend the use of computer technology to streamline the information functions in the training room. I have improved my time management significantly through the application of the electronic injury report system described in this paper. The minimal hardware and software requirements for this type of system include either a PC or dummy terminal in the training room and in each coach's office, word processing software, and communications software. Additionally, the PCs or terminals must be linked together, either through an institutional mainframe computer or a local area network (a group of computers that are hardwired together so they can share the same software and files). Although my system uses PCs and the institution's mainframe, Macintosh computers networked together with the appropriate software could serve this purpose. For those athletic trainers who need help in establishing such a system, I suggest you contact the computer professionals at your institution for advice and assistance. Those who would like a printed copy of the various batch files and macros needed to run the system may contact me at (616) 395-7708 or by e-mail, ray@hope.cit.hope.edu.

REFERENCES

- Abdenour TE. Computerized training room records. *Athl Train, JNATA*. 1982;17:191.
- Ingersoll CD. Computer networks and ATHTRN-L. Presented at the Annual Clinical Symposium of the National Athletic Trainers' Association; June 14, 1994; Dallas, TX.
- 3. Leroy L. A review of record keeping sports medicine computer software. *Athl Train, JNATA*. 1990;25:321–328.
- Ray R. Management Strategies in Athletic Training. Champaign, IL: Human Kinetics; 1994:158–170.
- Ray RR, Shire TL. An athletic training program in the computer age. *Athl Train, JNATA*. 1986;21:212–214.
- Ribaric R. The computer in sports medicine. *Athl Train, JNATA*. 1982; 17:309.

ew Products

ADJUST-A-STEP

The ADJUST-A-STEP, new from efi Medical Systems, is a multi-level, adjustable bench step that allows a patient to begin stepping protocols at very low levels and then work up to higher steps in small increments. Therapist designed, ADJUST-A-STEP allows stepping protocols as low as 2 inches off the ground up to the standard 8 inches in small calibrated increments of one-half inch.



ADJUST-A-STEP is functional rehabilitation made easy and fun. This one step replaces dozens of cumbersome individual pieces. Its tough, half-inch rubber stepping platforms, designed to flip from one side of the step to the other, create a step-through environment. With the need for functional testing and reporting, ADJUST-A-STEP is perfect for tracking functional progress in calibrated increments. ADJUST-A-STEP is the first adjustable bench step of its kind offering 13 different adaptations. Additional stepping platforms, up to 12 inches, are available.

For more information about ADJUST-A-STEP, call 800-541-4900.

Announcing the New Stairmaster[®] Spinnaker[™] 3600 RC[™] Recumbent Cycle

StairMaster Sports/Medical Products, Inc announces the newest addition to its superior line of conditioning and therapeutic products. Unlike traditional recumbent cycles that focus exclusively on comfort, the Spinnaker 3600 RC was designed for both comfort and safety, particularly for the knees. The resistance mechanism on

the 3600 RC protects the users knees by eliminating high resistance loads at low pedal speeds and by reducing the pedal force required to maintain the velocity at critical points during the cycle stroke. In addition, the resistance mechanism enables users to exercise at higher levels of intensity (thereby providing an enhanced conditioning effect) because unlike other recumbent cycles, the Spinnaker 3600 RC does not cause excessive localized fatigue in the quadricep muscles. Such fatigue can severely compromise the conditioning benefits the user achieves. As a result, the Spinnaker 3600 RC is by far the safest, most comfortable, and most effective recumbent cycle manufactured today.



For additional information, call 800-635-2936.

Carapace, Inc Introduces the EnduraSplint[®] 2 Splinting System

EnduraSplint 2 offers the strength of fiberglass without the mess! Our prepadded splints feature a soft polypropylene padding on the patient side with a low profile back cover that allows easy "no gloves" handling. EnduraSplint 2 individual splints are available in 7 sizes to fit the widest variety of splinting applications.

EnduraSplint 2 Splinting System is indicated for all trauma and secondary splinting applications where quick, rigid immobilization is desired.

One-sided polypropylene padding is "hydrophobic"; it sheds moisture faster and stays drier than open cell foam.



"Breathability" is improved to reduce the possibility of maceration. The padded side provides a soft, comfortable surface, with superior protection from sharp edges. The nonpadded side is a protective barrier of nonwoven material laminated to highly breathable DuPont[®] Hytrel[®]. One-sided padding makes a lighter, lower profile splint that dries more quickly.

For more information call 918-252-7266.

New Bunion Protector

Silipos Inc, manufacturers of advanced polymer technology, has added a new patented gel bunion protector to the Silopad[™] footcare product line. The Bunion Protector cushions and conforms to the painful



bone protrusion. The patented medical grade mineral oil gel has been molded into an aperturn design to properly absorb shear and friction forces while simultaneously moistening the irritated area. The product is available in two sizes and can be worn with either dress or casual shoes. A comfortable loop fits over the first toe to correctly position the protector over the bunion deformity.

For a complimentary sample of the gel and to find out about our introductory offer for this product, call 800-229-4404.

Silopad Mesh Tip Cap

Silipos, Inc has recently developed a new mesh cap for the protection and comfort of digital injuries and traumas. The Mesh Tip Cap is lined with the patented medical grade tri-block polymer gel used in all of the Silopad products. The Mesh Tip Cap has an extra layer of gel at the distal end of the cap and is designed to pad, cushion, protect and comfort the digit.



Suggested applications for this product are to protect and comfort partial digit amputations, sutured or scarred lesions, hammer toes, turf toes, and to absorb friction, blisters, and abrasion. The product is washable, reusable, and can be cut with scissors to insure proper fit. Mesh Tip Cap is available in one size to accommodate all five digits.

For more information and a sample of the gel, call 800-229-4404.

Lockhart Improves Its Splints For Toes

Lockhart Designs, a manufacturer of innovative medical products, announces major improvements in the wearing comfort and ease of fitting in its patented splints for toes.

The splints shapes were changed and felt pads were added to enhance comfort,

strength, and protection. The combination of changes works synergistically to make the splints more comfortable to wear and more effective as a healing aid. In addition, they are easier to apply.

The original splints gained enthusiastic support from many of their users. Lockhart splints isolate, protect, and align an injured toe by using the metatarsal bones of the foot as support. Patients fitted with them can often remain comfortably active while healing. Lockhart Toe Splints have been successfully used for treating broken toes, bruises, dislocations, sprains, and postsurgical protection.

Lockhart Toe Splints are made in shapes to fit greater, lesser, and middle toes. They can be purchased from Alimed, Micro Bio Medics, and Medpro or from Lockhart Designs at 1-800-FIX-TOES.

PROOF—Patient Report of Ongoing Function

PROOF, efi Medical System's new Patient Report of On-going Function, allows the clinician to objectively evaluate a patient's lower body function of involved versus uninvolved limb with two simple closed-chain functional tests performed on the Total Gym Therapy System. This PC DOS-based software calls for a test of power and a test of endurance. PROOF examines the data from both tests and converts the results into a uniform unit of power called a joule. Higher joule output indicates more strength, while lower output of joules indicates weakness. PROOF then compares the joule output of the involved leg versus the uninvolved leg and calculates the percentage deficiency of the involved leg.



Graduate Education Programs through the



"America's Graduate School of Sport"

Earn a Master's Degree

- Sports Medicine
 Sport Fitness
- Sport Coaching
- Sport Research
- Sport Management

Designed For The Working Professional

Flexible Practical experience for credit No loss of job

...Earn a **Doctorate Degree** in Sport Managment in summer sessions, practical experience mentorship, dissertation.

For Financial Aid and Admission information, call 1-800-223-2668 or write:

United States Sports Academy One Academy Drive Daphne, Alabama 36526 1-334-626-3303

> CEU credit through Distance Learning

The Academy is accrediated by the Commission on Colleges of the Southern Association of Colleges and Schools to award Master of Sport Science degrees (Level III) and is a Candidate for Accreditation to award the Doctor's degree (Level V). The Academy accepts students regardless of race, religion, sex, age, handicap, or national origin.

PROOF offers the therapist validation of closed-chain protocols and means of reporting patient progress. While thirdparty payers continually call upon therapists to reduce rehabilitation time, and capitation requirements demand validated methods of treatment PROOF enters the market none too soon. Its unique and simple testing procedures set up in less than 8 minutes, with retest set up in less than 4 minutes. PROOF duplicates the test exactly each time and its assessment directly relates to the patient's normal function rather than statistical norms. Printed documentation preserves the patient's progress assessment and provides reports of progress to the patient's physician. PROOF, with its cost-effective means of functional testing, requires minimal equipment purchase. The Total Gym Therapy System, used with PROOF, is a variable resistance, closed-chain training system making the PROOF System a high use, economical and effective clinical must.

For more information about PROOF and the Total Gym Therapy System, call 800-541-4900.

Ferno Ille Offers Complete Aquatic System

Ferno Ille, a division of Ferno-Washington, Inc, and a leader in the field of aquatic therapy, offers a complete system for the therapy of the future. It includes the AquaMotion[®] Therapy Pool, the AquaMotion In-Pool Treadmill and the AquaNex[™] Hydrodynamic Measurement System.

The AquaMotion Therapy Pools can be customized to meet the therapeutic needs of each clinic. And, they can be constructed with varying water depths to accommodate different treatment types.

Everything needed to provide quality aquatic therapy is included with the pool. Outside steps and deck, inside steps and platforms, plumbing, heating, filtration and purification systems are all part of the package.

The feature that makes the pool so unique is the clear, Plexiglas walls which allow the therapist to supervise and evaluate every patient movement without having to get into the pool. The number and location of the clear walls is determined only after a careful study of each facility's needs and space limitations.



The AquaMotion In-Pool Treadmill is designed to be dropped right into your AquaMotion or existing therapy pool with no modifications needed. The therapist control panel exists separately from the unit so that the therapist can control the patient's workout without getting in the water. The treadmill, which has speeds up to 6 miles per hour, can be reversed to provide intensive workouts for the gluteals and the hamstrings. It also features the AquaSoft[™] Low Impact Foot Plant System to further reduce concussive forces.

The AquaNex Hydrodynamic Measurement System is a computer software/ hardware system that provides instantaneous feedback regarding the forces exerted during aquatic therapy. It detects the forces exerted on limbs or other surfaces, such as aquatic equipment, moved through the water. It relays the information into a menu-driven, computerized unit for analysis, storage, and report printing. The data from multiple sessions may be printed in a summary report to illustrate a patient's progress.

For more information call 513-382-1451.

DONJOY Introduces Cold Therapy/Electrostimulation Treatment system

Smith & Nephew DonJoy has introduced "Pro-Stim[™]," a product designed to incorporate ice and compression with the added benefit of therapeutic electrical stimulation.

The treatment system consists of an insulated pouch that contains built-in electrodes, reusable "ice cubes," and elastic compression bandages. The conductive fabric electrode design allows the cold packs inside the pouch to conduct through the electrode, providing uniform cooling to the entire area being treated. Traditional methods of combining ICE with STIM only cools the area around the electrodes, with the key sites of treatment losing the therapeutic benefits of ice.

The Pro-Stim comes in three sizes for application to different areas of the body. The Pro-Stim Junior is designed for small, specific sites such as forearms, wrists and elbows; the Medium size is for treatment areas such as ankles, knees, arms, and shoulders, and the Large is ideal on backs, knees and shoulders.

For more information, call 800-336-6569.

Triple Patented Back Support Belts From Schiek's Provide Maximum Comfort and Support

Schiek's Sports, Inc has introduced its patented line of back support belts designed to provide ultimate protection to both the lower back and abdominal area. Unlike other back support belts, Schiek belts offer three distinct advantages not available anywhere else: a patented shape, exclusive hip and rib contour, and a patented Velcro[®] closure.

The patented design of the Schiek belt forms a therapeutic cone shape essential for comfort, support, and the perfect fit. Other belts take on a cylindrical figure and do not properly hug the contours of the human body, resulting in decreased support and comfort. Unlike conventional support belts, the patented design of the Schiek's model lends added strength to the spine and maintains proper alignment of the lower back.



Another unique advantage Schiek offers is the exclusive hip and rib contour. This means that Schiek belts are "tapered" to conform to the hips and ribs for improved comfort and flexibility. For example, the belt measures approximately $4^{3}4''$ on the back, tapers to $2\frac{1}{2}''$ on the sides, conforming to the hip and rib area, and then flares back out to about 4" in the front, providing necessary abdominal support. Whereas ordinary belts dig into the hips and ribs causing discomfort, the design of the Schiek belt allows for maximum flexibility and freedom of movement, while maintaining strong support.

The third distinct feature found only on a Schiek's support belt is its One-Way Velcro closure. As the belt is tightened, the velcro releases, sliding in one direction. Once the optimal tension has been achieved, the velcro adheres, locking the belt into position. Differing from belts with buckles, Schiek belts can easily be adjusted to the perfect tension during a workout.

Aside from these three patents found solely on a Schiek belt, a host of additional features incorporated into the belt further set it apart from others on the market. One of the keys to reducing the workload on the spine and back is proper coverage and support of the abdominal wall. Schiek's accomplishes this through the use of interlocking front belt panels, which compress abdominal muscles to increase Intra-Abdominal Pressure (IAP). This in turn inflates the abdominal cavity so it supports part of the load, helping to relieve the spine and back muscles when lifting, bending, pulling, and pushing.

The Special Lumbar Insert that is built into the rear portion of the belt is another distinguishing feature. This characteristic serves to reinforce the natural shape of the spine. It provides extra reinforcement and support through the critical lumbar curve in the lower back. In this area of the back where additional support is crucial, other nylon belts give way.

Schiek support belts are available in four models, depending on the individuals' needs. Belts can be ordered with or without suspenders and come in a variety of sizes and colors. All belts include a one-year warranty.

For more information call 800-772-4435.

New Exercise Ball Workout

Are you tired of trying to motivate your patients to continue boring exercise programs? Are you looking for a fun, but challenging, strengthening program? The Airobic Ball[™] Strengthening Workout: Strengthen Your Body and Get Fitter, Faster, With More Fun! may be just what you are looking for. Designed by a physical therapist, and endorsed by aerobics instructors and physicians, this workout incorporates the use of oversize vinyl Gymnic (Airobic) balls into a strengthening routine.



Commonly used in American and European rehabilitation programs, the balls are perfectly adapted for exercise. Workouts with the balls help improve posture, balance and coordination. When combined with the specific recommendations in The Airobic Ball Strengthening Workout, they can be used to help strengthen and tone the abdomen, arms, back, neck, buttocks, and legs. The exercises burn fat, improve posture, reduce stress, and strengthen bones.

The 72-page book provides guidelines for selecting, inflating, measuring and using different sized Swiss balls. Also included is general background information and tips on how to eat healthy and maintain a fitness regimen. Over 30 illustrated exercises are provided, one exercise per page. The photo illustrations and the instructions are clear and easy to understand.

The author, Caroline Creager, PT, is a physical therapist in private practice. She has authored other books on Swiss ball therapy, and offers courses on their use. She states that the Airobic Ball Workout is appropriate for all fitness levels, in-shape and out-of-shape. The balls are lightweight and portable, providing an exercise routine that can travel with the patient.

For more information and a free 30-page color catalog, call 800-367-7393.

Peak performance for your athletes

Lower Extremit

Orthoses and Accessories

1995

AliMed[®] Lower Extremities 1995 Orthoses and Accessories Catalog

Over 100 pages of innovative products developed to meet your patients' specific needs. Sports orthotics, splints, ankle supports, knee braces, cast walkers, exercisers, hot and cold therapy devices, accessories and much more. Order now!

For your FREE catalog, call 800-225-2610 8:00 am-8:00 pm ET Ask for catalog #1050



297 High Street, Dedham, MA 02026 ©1995 AliMed[®] inc. All rights reserved.

#2018

uthors' Guide

(Revised February 1992)

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

SUBMISSION POLICIES

- Submit one original and three copies of the entire manuscript (including photographs, artwork, and tables) to the editor.
- 2. All manuscripts must be accompanied by a letter signed by each author, and must contain the statements below. By signing the letter, the author(s) agrees to comply with all statements. Manuscripts that are not accompanied by such a letter will not be reviewed. "This manuscript contains original unpublished material that has been submitted solely to the Journal of Athletic Training, is not under simultaneous review by any other publication, and will not be submitted elsewhere until a decision has been made concerning its suitability for publication by the Journal of Athletic Training. In consideration of the NATA's taking action in reviewing and editing my (our) submission, the author(s) undersigned hereby transfers, assigns, or otherwise conveys all copyright ownership to the NATA, in the event that such work is published by the NATA.'
- 3. Materials taken from other sources, including text, illustrations, or tables, must be accompanied by a written statement giving the *Journal of Athletic Training* permission to reproduce the material. Photographs of individuals must be accompanied by a signed photograph release form. Accepted manuscripts become the property of the National Athletic Trainers' Association, Inc.
- The Journal of Athletic Training uses a double blind review process. Authors should not be identified in any way except on the title page.
- 5. Manuscripts are edited to improve the effectiveness of communication between the author and the readers, and to aid the author in presenting a work that is compatible with the style policies found in the AMA Manual of Style, 8th ed. (Williams & Wilkins) 1989. The author agrees to accept any minor corrections of the manuscript made by the editors.
- Published manuscripts and accompanying work cannot be returned. Unused manuscripts will be returned when submitted with a stamped, self-addressed envelope.

STYLE POLICIES

- The active voice is preferred. Use the third person for describing what happened. "I" or "we" (if more than one author) for describing what you did, and "you" or the imperative for instruction.
- Each page must be typewritten on one side of 8.5 × 11 inch plain paper, double spaced, with one-inch margins. Do not right justify pages.
- Manuscripts should contain the following, organized in the order listed below, with each section beginning on a separate page:
 - a. Title page
 - b. Acknowledgements
 - c. Abstract and Key Words (first numbered page)
 - d. Text (body of manuscript)
 - e. References
 - f. Tables-each on a separate page
 - g. Legends to illustrations
 - h. Illustrations
- Begin numbering the pages of your manuscript with the abstract page as #1; then, consecutively number all successive pages.
- 11. Titles should be brief within descriptive limits (a 16-word maximum is recommended). The name of the disability treated should be included in the title if it is the relevant factor, if the technique or type of treatment used is the prin-

ciple reason for the report, it should be in the title. Often both should appear.

- 12. The title page should also include the names, titles, and affiliations of each author, and the name, address, phone number, and fax number of the author to whom correspondence is to be directed.
- 13. A comprehensive abstract of 75 to 200 words must accompany all manuscripts except **Tips From the Field**. Number this page one, type the complete title (but not the author's name(s)) on the top, skip two lines, and begin the abstract. It should be a single paragraph and succinctly summarize the major intent of the manuscript, the major points of the body, and the author's summary and/or conclusions. It is unacceptable to state in the abstract words to the effect that "the significance of the information is discussed in the article." Also, do not confuse the abstract with the introduction
- 14. List three to six key words or phrases that can be used in a subject index to refer to your paper. These should be on the same page as, and following your abstract. For Tips From the Field, the key words should follow immediately after the title on the first numbered page.
- Begin the text of the manuscript with an introductory paragraph or two in which the purpose or hypothesis of the article is clearly developed and stated. Tell why the study needed to be done or the article written and culminate with a statement of the problem (or controversy). Highlights of the most prominent works of others as related to your subject are often appropriate for the introduction, but a detailed review of the literature should be reserved for the discussion section. In the one to two paragraph review of the literature, identify and develop the magnitude and significance of the controversy, pointing out differences between others' results, conclusions, and/or opinions. The introduction is not the place for great detail; state the facts in brief specific statements and reference them. The detail belongs in the discussion. Also, an overview of the manuscript is part of the abstract, not the introduction.
- 16. The body or main part of the manuscript varies according to the type of article (examples follow); however, the body should include a discussion section in which the importance of the material presented is discussed and related to other pertinent literature. Liberal use of headings and subheadings, charts, graphs, and figures is recommended.
 - a. The body of an Experimental Report consists of a methodology section, a presentation of the results, and a discussion of the results. The methodology section should contain sufficient detail concerning the methods, procedures, and apparatus employed so that others can reproduce the results. The results should be summarized using descriptive and inferential statistics, and a few well planned and carefully constructed illustrations.
 - b. The body of a **Review of the Literature** article should be organized into subsections in which related thoughts of others are presented, summarized, and referenced. Each subsection should have a heading and brief summary, possibly one sentence. Sections must be arranged so that they progressively focus on the problem or question posed in the introduction.
 - c. The body of a Case Study should include the following components: personal data (age, sex, race, marital status, and occupation when relevant—but not name), chief complaint, history of present complaint (including symptoms), results of physical examination (example: "Physical findings relevant to the rehabilitation program were..."), medical history (surgery, laboratory results, exam, etc.), diagnosis, treatment and clinical course (rehabilitation until and after return to competition), criteria for re-turn to competition, and deviation from the expected (what makes this case unique). NOTE: It is mandatory

that the Journal of Athletic Training receive, with the manuscript, a release form signed by the individual being discussed in the case study. Case studies cannot be reviewed if the release is not included.

- d. The body of a Technique Article should include both the how and why of the technique, a step-by-step explanation of how to perform the technique, supplemented by photographs or illustrations; and why the technique should be used. The discussion of why should review similar techniques, point out how the new technique differs, and explain the advantages and disadvantages of the technique in comparison to the other techniques.
- e. A **Tip From the Field** is similar to a technique article but much shorter. The tip should be presented and its significance briefly discussed and related to other similar techniques.
- 17. The manuscript should not have a separate summary section—the abstract serves as a summary. It is appropriate, however, to tie the article together with a summary paragraph or list of conclusions at the end of the discussion section.
- 18. Citations in the text of the manuscript take the form of a superscripted number, which indicates the number assigned to the citation. It is placed directly after the reference or the name of the author being cited. References should be used liberally. It is unethical to present others' ideas as your own. Also, use references so that readers who desire further information on the topic can benefit from your scholarship.
- 19. The reference page(s) accompanying a manuscript should list authors numerically in alphabetical order, should be in the following form: a) articles: author(s) (list all) with the family names then initials, title of article, journal title with abbreviations as per *Index Medicus* (italicized or underlined), volume, year, inclusive pages; b) books: author(s), title of book (underlined), city, state of publication, publisher, year, inclusive pages of citation. Examples of references to a journal, book, presentation at a meeting are illustrated below. See the AMA Manual of Style for other examples.
 - a. Knight K. Tips for scientific/medical writers. Athl Train, JNATA. 1990;25:47–50.
 - b. Day RA. How to Write and Publish a Scientific Paper. 3rd ed. Phoenix, AZ: Oryx Press; 1988;54–55.
 - c. Albohm M. Common injuries in women's volleyball. In: Scriber K, Burke EJ, eds. *Relevant Topics in Athletic Training*. Ithaca, NY: Mouvement Publications; 1978:79–81.
 - d. Behnke R. Licensure for athletic trainers: problems and solutions. presented at the 29th Annual Meeting and Clinical Symposium of the National Athletic Trainers' Association; June 15, 1978; Las Vegas, NV.
- Tables must be typed. See references cited in #5 or #19a for table formatting.
- 21. Type legends to illustrations on a separate page followed by Xerox copies of the illustrations. Photographs should be glossy black and white prints. Do not use paper clips, write on photos, or attach photos to sheets of paper. Carefully attach a write-on label to the back of each photograph so that the photograph is not damaged. Graphs, charts, or figures should be of good quality and clearly presented on white paper, 3½" or 7¼" wide, with black ink, 8 to 10 point sans serif typeface, no box, and printed on laser printer—no dot matrix.
- 22. All artwork to be reproduced should be submitted as camera-ready black and white line art. If artwork is to be reproduced in black plus a second (or more) color, it should be submitted as black and white line art. Clearly mark each area of color, or areas of shading or screening (a percent or tint of black or a color), on a separate photocopy. Authors will pay for color.

NATA Research & Education Foundation 1995 Request For Proposals

The National Athletic Trainers' Association Research & Education Foundation is pleased to announce that \$75 000 is available during 1995 to fund research which enhances the health care of the physically active.

Of this total, \$50 000 will be used to fund proposals which address important issues in five categories: basic science, clinical studies, sports injury epidemiology, educational research, and observational studies. The Foundation has designated the remaining \$25 000 to fund studies which investigate the validity and efficacy of therapeutic techniques, modalities, clinical procedures, and equipmentation used by allied health practitioners. Grant application submission deadlines are March 1 and September 1 of each year (please note the new Fall deadline). Priority consideration will be given to research proposals which include an NATA-certified athletic trainer as an integral member of the research team. Proposed studies may be one or two years duration.

Research grant applications and guidelines may be obtained by writing to the NATA Research & Education Foundation, 2952 Stemmons Freeway, Dallas, TX 75247, calling 800-TRY-NATA, ext. 142, faxing the request to 214–637-2206 or e-mailing the request to brianae @aol.com.

Over a Decade of Results...

THE MULTIAXIAL® ANKLE EXERCISER

The MULTIAXIAL[®] Ankle Exerciser saves time, space and wear and tear on your isokinetic equipment while offering your patient the very best in therapeutic exercise at a reasonable cost.

- all joint ranges of motion
- · closed chain kinetic exercise through universal movement
- smooth action and adjustable progressive calibrated resistance with new zero degree stop
- easy to set up and stabilize by your treatment table
- balanced, biomechanical compartment loading plus chart of 15 comprehensive patterns of exercise

FOR MORE INFORMATION, PLEASE CONTACT



MULTIAXIAL[®] INC. P.O. Box 404, Lincoln, Rhode Island 02865 • (401) 723-2525

NATA RESEARCH AND EDUCATION FOUNDATION CALL FOR ABSTRACTS

all For Abstracts

1996 NATIONAL ATHLETIC TRAINERS' ASSOCIATION ANNUAL MEETING: ORLANDO, FLORIDA, JUNE 12–15, 1996 (DEADLINE FOR ABSTRACT SUBMISSION: JANUARY 5, 1996)

INSTRUCTIONS FOR SUBMISSION OF ABSTRACTS AND PROCESS FOR REVIEW OF ALL SUBMISSIONS

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

I. SPECIFIC CONTENT REQUIREMENTS: FREE COMMUNICATIONS ABSTRACTS

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

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

II. INSTRUCTIONS FOR PREPARING A FREE COMMUNICATIONS ABSTRACT:

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

III. SPECIFIC CONTENT REQUIREMENTS: CLINICAL CASE REPORTS

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

a 2-page format. A maximum of one paragraph should be presented for each of the following required content area headings: 1) Personal data, 2) Physical signs and symptoms, 3) Differential diagnosis, 4) Results of diagnostic imaging/laboratory tests, 5) Clinical course, and 6) Deviation from the expected.

IV. INSTRUCTIONS FOR PREPARING A CLINICAL CASE REPORT ABSTRACT:

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

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

 Complete the form and mail it, the original abstract, two photocopies of the original abstract, six (6) blind copies (showing no information about the authors or institution) of the Abstract and a labeled 3.5" DISKETTE copy (preferably in WordPerfect or ACSII format; if you must send it in MacIntosh format, please use a high-density diskette) of your abstract and the following author information to:

> NATA-REF Free Communications 2952 Stemmons Freeway Dallas, TX 75247

Name		Indicate the most app the presentation (che	propriate TYPE for ck one only):
Address		Clinical Case Report	Free Communication
City	State Zip	If FREE COMMUN the most appropriate your presentation (ch	ICATION, indicate CATEGORY for neck one only):
Work Tel:	FAX:	Basic Science	Clinical Studies
NATA Membership Nun KEY WORDS (2-6 word	nber	Educational Research Observational St	Sports Injury Epidemiology udies
		Indicate your present (check one only; cho influence acceptance) Poster Or	tation preference bice does not): ral Indifferent

2. Abstracts POSTMARKED AFTER JANUARY 5, 1996 WILL NOT BE ACCEPTED.



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

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

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

	Volum	ie 30, N	umber 1	
1. e	4. b	7. a	10. e	13. d
2. a	5. d	8. d	11. e	14. a
3.c	6. d	9. c	12. b	15. b

	Please check here if this is your first CEU Quiz or if your address has changed since your last quiz.
	NATA Membership Number or NATABOC Certification Number (please check one)
Soc	ial Security Number
Na	me
Ma	iling Address
Cit	y State Zip
Ins	titution or Team
Ple	ase indicate below the setting in which you work:
	High School 📮 Junior College 📮 College
	University Dig Sports Medicine Center

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.
- Mail with \$15 fee (check or money order only payable to Indiana State University) postmarked by September 15, 1995 to:

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

CEU Quiz Evaluation	
1. Questions challenging enough?	
2. Presented clearly?	□Yes □No
3. Material covered well?	□Yes □No
4. Will information be useful to you in	your
work?	QYes QNo
Please add any suggestions on how to in	nprove the
CEU Quiz on the back of this form whe	en you are
finished.	

RECO	RECORD ANSWERS HERE - Darken the appropriate letter. Example: 1 a • c d e																
1	a	Ь	С	d	е	6	a	b	c	d	e	11	а	b	c	d	e
2	a	b	c	d	e	7	а	b	с	d	е	12	a	b	c	d	e
3	a	b	с	d	е	8	a	b	с	d	е	13	a	Ь	с	d	e
4	a	b	c	d	е	9	а	Ь	c	d	е	14	a	b	c	d	e
5	а	b	с	d	e	10	a	b	с	d	e	15	a	b	с	d	е

MARK ANSWERS ON PREVIOUS PAGE.

- 1. Measure of functional range of motion in ankles while taped and wearing semirigid orthoses showed that:
 - a. adhesive tape with moleskin significantly affected functional range of motion during running.
 - b. the Ankle Ligament Protector was the only supportive device that was significantly restrictive.
 - c. the Airstirrup was significantly restrictive.
 - d. the Active Ankle was significantly restrictive.
 - e. None of the above.

2. Recognizable signs of distal femoral physeal injuries include which of the following?

- a. Angular deformity and ecchymosis are usually present.
- b. Observation usually shows rapid effusion.
- c. Pain and crepitus are always present.
- d. both a and b.
- e. both c and d.
- 3. A study of the need for athletic trainers in the public secondary schools of Hawaii showed that:
 - a. public schools were inadequately funded, but private schools fared even worse.
 - b. legislators were unaware that certified athletic trainers were recognized by the AMA as allied health care professionals.
 - c. the legislature in Hawaii viewed athletic trainers as self-serving by promoting their own profession in the way that they did.
 - d. although they made a strong case, Hawaii's zero-growth budget proposal proved to be a defeat for the athletic directors and their allies.
 - e. both a and b.
- 4. Important differences between NATA and CAAHEP athletic training education program essentials and standards for accreditation include:
 - a. CAAHEP's statement on fair practice policies is more explicit than that of the NATA.
 - b. Policies regarding financial obligations for institutions are very similar between NATA and CAAHEP.
 - c. NATA's focus was on outcome of the educational experience; CAAHEP's focus is on the educational process.
 - d. Issues of human resources are the same in both programs.
 - e. both a and c
- 5. Research has shown that wounds treated by occlusion:
 - a. heal more rapidly.
 - b. are less painful.
 - c. are more prone to infection.
 - d. keep the wound bed drier.
 - e. a and b only

- 6. Which of the following statements are probably true, based on the case study on infective endocarditis?
 - a. The sports literature suggests that wrestlers are at a greater risk for infective endocarditis than are other healthy athletes.
 - b. A wrestler with open skin wounds participating on porous mats in humid conditions with inadequate ventilation can be infected with the microorganism for endocarditis even though he is otherwise healthy.
 - c. Daily mat cleaning with a bactericidal agent would be of little help and is not necessary for wrestling surfaces in order to prevent endocarditis.
 - d. Even in the most adverse conditions, such as unclean mats and poor ventilation, an otherwise healthy wrestler would not become infected. He would have to have a history of an underlying heart condition to become infected.
 - e. both a and d
- 7. With slipped capital femoral epiphysis, during passive flexion of the hip, the affected hip will internally rotate more than the hip on the contralateral side.
 - a. True
 - b. False
- 8. Which of the following statements, if any, are thought to be true about wound management?
 - a. Bacteria are present in wounds and hinder the wound repair process.
 - b. Increased oxygen partial pressure is thought to be an important factor in re-epithelialization, but unimportant to the reduced incidence of infections.
 - c. Tenderness, a wide margin of erythema, and seeping exudate on pressure are important differentiating features of infection.
 - d. None of the above.
 - e. All of the above.
- 9. Although the benefits of early passive motion of a joint following the trauma of surgery are reported in the literature, the use of continuous passive motion on the knee joint following ACL surgery does not increase nutrient uptake.
 - a. True
 - b. False
- 10. A study on knee braces showed that gait is not adversely affected in subjects running on a treadmill; thus, the increased incidence of injuries reported for subjects wearing a specific brace must be attributed to other factors.
 - a. True
 - b. False
- 11. An important distinction between thoracic compression fractures and other vertebral fractures is that:

- a. the middle column of the spine is distracted in a compression fracture.
- b. the middle column of the spine remains intact in a compression fracture.
- c. the anterior column of the spine remains intact in a compression fracture.
- d. the posterior column of the spine remains intact in a compression fracture. e. both b and c.
- 12. Athletic trainers need to be aware of injuries to the distal femoral physis because:
 - a. at least three-fourths of all injuries at this site occur during sports activities.
 - b. this injury must be included in the differential evaluation of adolescent knee injuries.
 - c. injuries at this site could result in deformity.
 - d. a and b
 - e. b and c
- 13. Semipermeable dressings for wounds:
 - a. are superabsorbent.
 - b. are advised for heavily draining wounds.
 - c. conform to body contours.
 - d. require frequent changes.
 - e. both c and d.
- 14. Seborrheic dermatitis:
 - a. is a complication of wound healing and may be confused with infection.
 - b. is often treated with topical corticosteroids
 - c. when treated with anti-inflammatory corticosteroids, may slow the speed of wound resurfacing.
 - d. All of the above.
 - e. a and b only
- 15. The standard approach for management and treatment of stable throracolumbar compression fractures has been:
 - a. operative.
 - b. nonoperative.
 - early ambulation in a hyperextension orthosis or cast.
 - d bed rest
 - e. both b and c.

ADVERTISING INDEX

JOHNSON & JOHNSON
LENOX HILL BRACE COCover 3
MCDAVID KNEE GUARD, INC147
MEDICAL SPECIALTIES, INC
MEDIQUE PRODUCTS
MUELLER SPORTS MEDICINE, INC141
MULTIAXIAL, INC
OMNI SCIENTIFIC, INC153
OUTBACK SECRETS INTERNATIONAL166
PREPAK PRODUCTS140
PRO ORTHOPEDIC DEVICESCover 2
PROTEK-TOE PRODUCTS157
STAIRMASTER SPORTS/MEDICAL PRODUCTS,
INC
SWEDE-O, INC
UNITED STATES SPORTS ACADEMY
WILLIAMS & WILKINS145

NFL Training Staff of the Yea





7201 Friendship Road • Pittsville, MD 21850 • 1-800-HOT-FOOT • 410-835-3668

"Make that a Precision-Lite "

In stock. On-the-shelf. No wait!



Poster available 1-800-222-8837 for details

FAX 1-800-638-9795

Or write: LENOX HILL[®] Brace Company 11-20 43rd Road, Long Island City, NY 11101



The game has changed. Thirst hasn't.

Lhirty-eight years ago, 3-pointers were unheard of. Shot clocks weren't even ticking yet. And uniforms? Well, they were a lot tighter.

But when players worked up a sweat back in 1957, they felt the same way athletes do today. Thirsty.

That's why, then as now, trainers and coaches filled their coolers with Quickick[®] — an electrolyte drink. Quickick is the *original* fluid replacement drink. And it's still the best.



Other sports drinks are made with sucrose or dextrose. Sugars that can cause extreme energy highs, followed by extreme energy lows. The result? Inconsistent performance on the court, track or field. But Quickick is made with fructose. An all-natural sugar that sustains its energy boost longer, allowing your athletes to maintain a higher level of performance.

So if you want to win in the 90s, you may have to change your strategy... or your line-up... maybe even your haircuts. But whatever you do, stick with the original sports drink. Quickick from Cramer.



The world leader in sports medicine since 1918.