

# JOURNAL OF ATHLETIC TRAINING

*Official Publication of The National Athletic Trainers' Association*



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VOLUME 28

NUMBER 2

SUMMER 1993

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Volume 28, Number 2, Summer

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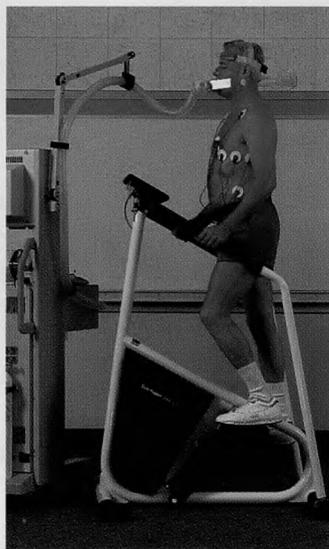
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## L

## etters to the Editor

**ATCs vs EMTs: Communication is the Name of the Game**

Time and again, I hear about EMTs and Athletic Trainers disagreeing on how an injured athlete on a field or court should be treated for his/her injuries. Usually, both professionals bicker at the scene of injury over the treatment, or lack of treatment, to an injured athlete. Much of the time, these problems arise because of a lack of communication. Emergency Medical Services (EMS) is a unique profession, as is the field of Sports Medicine. When an athlete gets injured and requires ambulance transport to a local emergency room, it is necessary for the local EMS services and the ATC to have a plan of action. Both professionals have a need and a moral and ethical obligation to provide the injured athlete with the highest quality of care possible. A breakdown in communications between either professional may jeopardize this care.

Athletic Trainers should make an effort to find out about the local EMS response team. Go down and visit the crews who might be responding to your field. Introduce yourself. Tell them who you are, what your level of training is, and explain to them why you are there.

You may want to find out from them: Are they paramedics, EMTs, or first responders? What exactly can they do? Do police and fire units respond on ambulance calls? What role do they play in patient care? Is the Basic Life Support (BLS) or Advanced Life Support (ALS) unit on all day? Do they come from the same location? How long does it usually take for the ambulance to arrive after the initial call? What do they carry on their ambulances? What information do they want from you, the ATC, when the EMS unit arrives? What can you (the ATC) do to make their job easier, and vice versa?

When an ambulance covers your

events, go up to the unit and introduce yourself. You might even see one or two of the EMS personnel that you met at their office. Tell them who you are and how you would like to handle an injury if one occurs. This simple step and approach usually "breaks the ice" and lets the EMS unit know that there is a qualified medical professional on the field.

It doesn't hurt to keep your town or city EMS personnel informed of items that may be of interest to them. You may want to send them an invitation to a coach's lecture on athletic injuries, etc. They, in turn, may send a letter to you to sit in on their CPR-refresher class. Are you wondering how they might respond to removing or not removing a football helmet? Talk to the EMS personnel about this situation and what you would or would not like to do if the situation arises. A little teamwork can make the situation run much smoother.

No matter how you look at it, it all comes down to communication. If you can't communicate with each other, it is usually the injured athlete who suffers.

*Frank A. Mastrangelo, ATC, EMT-A*  
Racine Sports Medicine Center  
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**Vaccines for student ATs**

As a student athletic trainer at Springfield College, one of my duties is to give first aid to athletes with open wounds. Consequently, I am exposed to diseases carried in the blood. To compound this, athletes are not required to inform me or anyone else about diseases which they know they have.

There are, however, vaccines for some of these diseases, and one of them is for hepatitis B. The hepatitis B virus attacks your liver and destroys the blood filtering system of the body. If carriers are not treated with a postexposure im-

munizing agent, the disease will kill them.

Although there is treatment for individuals who contract the virus, there is also a vaccine which makes you immune to the virus. The college provides immunization for the hepatitis B virus to the directors of the Athletic Training program. Ironically enough, these individuals are not exposed to athlete's blood, diseased or clean, nearly as much as the student athletic trainers are. Yet they are immunized, and the student trainer is not.

The vaccine is a series of three intramuscular injections of a genetically engineered vaccine produced in yeast cells by recombinant DNA technology. The vaccine stimulates immunity against subtypes of the hepatitis B virus. The cost of this vaccination is (on the average) \$600.00, and for a student (trainer or not), this is quite a fee to add onto the already inflated cost of college. Why, then, are the athletic trainers least exposed to the risk of catching hepatitis B immunized at no cost, while their pupils, who have a greater chance of catching such a disease, required to pay for their own immunization?

Is it because we are not yet certified? Is it that we are not worth the money yet, because we are not experienced enough in the profession? If that is the reasoning behind the school's policy, then I think the college should consider working with the student trainers to make a new policy. Because if they don't, the trainers who cannot afford the vaccine could possibly contract the virus without knowing it, and possibly die. The athletic training profession is still very young. Why risk stunting its future population because of finances?

*Damien Pusey, AT*  
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Springfield College  
Springfield, MA 01109

### Credential Misrepresentation

I would like to express deep concern towards the article "The Role of Limb Torque, Muscle Action, and Proprioception During Closed Kinetic Chain Rehabilitation of the Lower Extremity" in the Spring 1993 issue. At first glance, I was elated that the four authors all had the credentials of ATC, were from the same area of Michigan where I am currently employed, and were publishing a much-needed article on closed chain rehabilitation.

As quickly as the excitement came upon me, anger surfaced just as fast. I find it very disturbing that two of the authors have the initials ATC after their name and use the title of "Clinical Athletic Therapist." I admit that "Certified Athletic Trainer" may not justly represent my professional responsibilities. However, this can be said for other health professionals as well. I do not condone the misrepresentation of other health professionals and do not condone it from these authors.

If these authors feel it is lack of public education causing them to misrepresent themselves, I think they should learn to confront this obstacle as the entire athletic training profession has at one time or another, and provide honest and proud representation of their knowledge and skills. The athletic training profession will never get the respect it deserves if ATCs continue to ignore their own professional title.

I am not only disturbed with the authors; I am also disturbed with the journal. It is my understanding that the NATA just spent thousands of dollars in legal fees to protect not only the initials ATC, but also the title "Certified Athletic Trainer." How can the journal representing the NATA misrepresent the title "Certified Athletic Trainer?"

I think this article had the opportunity to educate allied health professionals, not only with closed chain rehabilitation, but also to the clinical skills of Certified Athletic Trainers. However, in my opinion, it brings a

stronger issue to light. Maybe the NATA needs to reevaluate the title "Certified Athletic Trainer" to better represent the profession. Until this is completed, I would hope that those who misrepresent themselves are not supported by this journal or the NATA.

*Ann L. Berry, ATC*  
Advanced Physical Therapy  
Dearborn, MI

### Drug Testing

Recently the issue of drugs and drug testing among college in the NCAA has been a popular topic. I am particularly interested in this field and feel very strongly about the need for control. I chose to express my opinion in an editorial-type letter.

With the use and abuse of drugs increasing steadily amongst not only our professional and collegiate athletes but also our junior and senior high school students, the need for a little bit of control or, at the very least, detection of these drugs is warranted. Let's face it. Education alone is not proving to be very effective. These athletes know what effect the drugs can have on them, but they are choosing to ignore the facts anyway. Increasing individuals' knowledge about a drug will not necessarily change their attitude or behavior towards the use of drugs. The necessity for a stronger control that works, such as drug testing, far outweighs the slight embarrassment some athletes may experience during the process.

The question of whether or not drug testing is an invasion of privacy is fast becoming a popular debate. Many, as shown through the lawsuits that keep springing up around the country, feel it is, but, to many others, it is not even a question. Since the NCAA started its mandatory drug testing of all nationally competitive collegiate athletes in 1986, the statistics of drug use among these athletes has dropped. Some may claim that it is because the athletes have

thought of better ways to fool the tests, but this could only account for a small percentage of the drop. It is more sensible to assume that these athletes are alarmed; the NCAA means business. Why else would the NCAA go through all the trouble of watching an athlete urinate if it was not important?

Although the process of drug testing is not the most private affair, how else can the specimen be guaranteed accurate? If an attendant is not present, who is to say the athlete will use his or her own specimen, especially if he or she knows it would not pass? Moreover, an athlete found guilty could complain that his or her specimen was tampered with. Having an attendant present is the most reliable and key step in ensuring that the athlete's urine sample is genuine, untampered with, and belongs to the correct individual.

Looking at the process from an objective point of view, how is it much different from urinating in a public rest room? Privacy is not exactly at its peak level there and no one complains. Athletes dispose of their bodily fluids in front of one another everyday in a locker room, and they also undress and shower in front of each other without thinking twice about it. Yet, in drug testing, a process designed to help, protect, and benefit the athlete, it is the athlete who is screaming invasion of privacy or infringement on personal rights. Maybe these athletes really do have something to hide from the NCAA.

Society, unfortunately, does not function on its own paradigm "innocent until proven guilty" (although it should). It is the other way around, and athletes who are clean and innocent, need to be given the opportunity to show their innocence one hundred percent guaranteed, no questions asked.

*Kimberly Schaffner, ATC*  
Ithaca College Graduate Student



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# Concentric Isokinetic Trunk Extension/Flexion Testing of Rigid and Semirigid Lumbar/Sacral Supports

M.L. Woodhouse, PhD, ATC  
James R.K. Heinen, PhD  
Lawrence Shall, MD  
Kathryn Bragg, PT

**Abstract:** Using a Cybex® trunk extension/flexion device, we measured the effects of rigid and semirigid lumbar/sacral supports on peak muscular torque, total work, and average power. Ten well-conditioned men, aged 21 to 35, performed three testing sessions each at 7-day intervals (one session with a rigid support, one session with a semirigid support, and one with no support). We selected four isokinetic testing speeds (30°/s, 60°/s, 90°/s, and 120°/s), complying with a standard Cybex trunk extension/flexion protocol. Differences between lumbar/sacral supports were analyzed using an analysis of variance (ANOVA) and Scheffé post hoc tests. Peak torque, total work, and average power were

significantly different ( $p < .05$ ) during trunk flexion at various isokinetic velocities. Trunk extension movements did not appear to be affected by the use of supports, but trunk flexion was significantly greater with the semirigid device and with no device than with the rigid support. We concluded that a rigid lumbar/sacral support decreases strength during movement tasks involving trunk flexion with resistance.

Isokinetic strength testing of lumbar/sacral movements, considered safe and reliable,<sup>4,10,11,13,15</sup> provides an objective and quantitative analysis of spine function. Logically, back isokinetic equipment can determine changes in performance as a result of low-back supportive devices.

Previous studies<sup>1,7,9,20</sup> on the effects of specific lumbar/sacral supports failed to measure the effects of these devices during spinal flexion and extension. Lumbar/sacral support is important during flexion/extension because of the biomechanical vulnerability of the spine.<sup>6,14,15</sup> However, the functional implications of the devices have not been determined. Earlier investigations<sup>1,9,14,20</sup> failed to monitor changes in motor performance while the low back was contained or supported by a lumbar/sacral device. Thus, back strength needs to be evaluated with low-back

supportive devices in use.

To determine how lumbar/sacral supports might affect peak torque, total work, and average power generated by the trunk musculature, we tested subjects using the semirigid Proflex™ (Ergodyne Corporation; P.O. Box 4395; St. Paul, MN 55104) abdominal support and traditional leather weight-training belt. Both of these devices provide external support, improve lifting performance, and increase intra-abdominal pressure.<sup>2,3,5,7-9,14,16-20</sup> Based on the premise that an abdominal pad provides an opposing force against the abdominal cavity, as well as a rigid supportive surface for the abdominal wall,<sup>7,14,18-20</sup> we modified a traditional weight-training belt with a rigid abdominal pad to determine any further effect on spinal flexion/extension.<sup>14,18-20</sup>

## Methods

We used a repeated measures, quasi-experimental design to study the effect of the independent variable (lumbar/sacral support) on the dependent variables of peak torque, total work, and average power.

We chose 10 well-conditioned men to participate in the study (ht=70±2.7 in, wt=174±35 lb, waist=35±3.5 in, age=26±4 yrs). After signing an informed consent, each subject received a physical examination which included anterior/posterior and lateral x-rays of the lumbar/sacral spine to determine any pathological condition that could hinder resistive spinal movement. Volunteers omitted from the study included those with previous inflammatory or post-traumatic back pathology, those with acute back pain, and those with reduced active trunk range of motion (determined with a conventional goniometer—flexion -80°, extension -30°, lateral flexion -20°, and left/right rotation -30°).

Subjects performed three counter-balanced testing sessions with each lumbar/sacral support and one without any back support device. These sessions were separated by a 7-day recovery period. Testing procedures followed standard Cybex testing protocols.<sup>4</sup>

Subjects warmed up for 20 minutes

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James Heinen is an associate professor with the College of Education at Old Dominion University in Norfolk, VA.

Lawrence Shall is an associate professor with the Department of Orthopaedics at Eastern Virginia Medical School in Norfolk, VA.

Kathryn Bragg is a physical therapist at Depaul Hospital in Norfolk, VA.

before putting on the lumbar/sacral support. Exercises included 10 minutes of cycling on a Fitron® cycle ergometer (120 rpm x 10 min—load to tolerance) and 10 minutes of doing general calisthenics and large muscle static stretching.

Prior to each test, subjects performed 4 trial repetitions, 3 submaximal and 1 maximal. During testing, our physical therapist gave standard verbal encouragement to each subject, which was monitored for consistency by the principal investigator. Isokinetic testing included a 15-second rest period following each testing speed (30°/s for 5 repetitions; 60°/s for 5 repetitions; 90°/s for 5 repetitions; 120°/s for 8 repetitions). Location, time of testing, temperature, and Cybex testing protocol remained constant throughout the investigation.

Subjects performed trunk movement tasks on the Cybex trunk extension/flexion device (Fig 1), using isokinetic resistance specific to standard Cybex testing protocol. The Cybex device was calibrated according to the manufacturer's guidelines (°/s) before and after each testing session to ensure data reliability. Subjects followed standard Cybex trunk extension/flexion testing procedures for position and stability to ensure reproducible, accurate measurements.<sup>4</sup> Our physical therapist recorded individual vertical and horizontal plane alignments for each subject. The vertical trunk extension/flexion axis was aligned with the fifth lumbar/first sacral vertebrae; the horizontal axis was aligned with that of the midaxilla and the fifth lumbar and first sacral vertebrae.

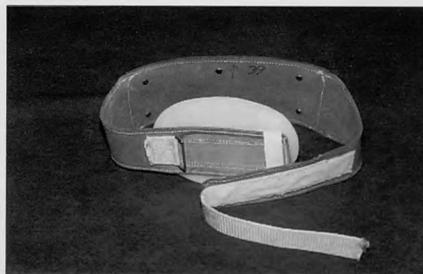
Vertical and horizontal axis positions were stabilized for safety and data accuracy by trunk extension/flexion locking pads and belts. A thigh and tibial pad and a popliteal pad stabilized the lower body, while an automotive-style pelvic belt provided additional lower body stability. A chest and scapular pad attached with buckles and clamps provided appropriate tightness during trunk flexion/extension.

To provide accurate fitting of each lumbar/sacral support, we measured each subject's waist halfway between



**Fig 1.—Cybex trunk extension/flexion (TEF) device; Ronkonkoma, NY.**

the anterior superior iliac spine and the greater trochanter of the femur.<sup>12,14</sup> Because the buckle and keeper on commercially available weight belts could have interfered with the rigid abdominal pad, a certified orthotist designed rigid experimental belts. These experimental supports (Booden Orthopaedic Supply; 2418 Granby Street; Norfolk, VA 23517) came in three lengths (32-36 in; 36-39 in; 39-44 in) to accommodate varying pelvic and waist measurements (Fig 2). Each support, similar to a traditional weight-training belt, was made of leather with a rigid plastic abdominal pad and adjustable front Velcro™ closures. The adjustable rigid abdominal pad was attached with Velcro to the back portion of the leather belt. Dimensions of the pad were: height = 5-3/4 in; width = 8-1/4 in; depth = 3/8 in. The pads were positioned vertically from the pubis to the subcostal angle and were centered horizontally between



**Fig 2.—Experimental back support with rigid abdominal pad.**

the anterior superior iliac spines. The pad provided an opposing force and rigid surface for the abdominal wall without bony contact.

The semirigid support devices were Proflex back supports (Fig 3; Ergodyne Corporation; P.O. Box 4395; St. Paul, MN 55104) made of nylon with front Velcro closures and adjustable back crossing suspenders. The Proflex device is contoured (7 to 9 inches side-to-back) with supportive aluminum stays and bilateral elastic Velcro to adjust tightness.

Data were analyzed using a series of one-way analyses of variance (ANOVA) with repeated measures. Trunk motions (flexion/extension) and testing speeds (30°, 60°, 90°, and 120°/s) were analyzed separately for peak torque, total work, and average power. Statistically significant differences were tested using Scheffé post hoc tests (alpha <.05). We chose not to analyze data by factorial ANOVA because trunk



**Fig 3.—Proflex back support.**

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**Table 1.—Peak Torque for Trunk Flexion/Extension at 30°, 60°, 90° and 120°/s (Ft-lb; Mean ± SD).**

Speed (°/s)	LUMBAR / SACRAL SUPPORTS		
	Proflex	Experimental Belt	Control
<b>Trunk Flexion</b>			
30*	157.4 (45.3)	148.2 (38.0)	164.4 (41.0)
60**	147.0 (38.4)	143.0 (46.0)	153.0 (35.0)
90*	147.0 (40.0)	138.0 (39.1)	149.4 (34.0)
120***	144.0 (44.3)	135.0 (38.0)	147.2 (29.4)
<b>Trunk Extension</b>			
30	237.0 (93.1)	239.0 (78.4)	229.0 (81.4)
60	226.2 (81.0)	226.0 (75.0)	223.0 (72.0)
90	216.0 (72.4)	217.4 (74.1)	213.1 (65.2)
120	203.0 (57.0)	199.4 (62.3)	200.0 (63.0)

\*p=.01, \*\*p=.09, \*\*\*p=.04

**Table 2.—Total work for trunk flexion/extension at 30°, 60°, 90°, and 120°/s (Ft-lb; Mean ± SD).**

Speed (°/s)	LUMBAR / SACRAL SUPPORTS		
	Proflex	Experimental Belt	Control
<b>Trunk Flexion</b>			
30*	194.0 (61.0)	182.0 (54.0)	201.0 (54.3)
60**	180.3 (49.0)	175.4 (55.0)	190.0 (44.0)
90**	174.1 (48.0)	169.3 (49.0)	183.0 (41.2)
120***	169.0 (46.3)	162.0 (46.0)	176.0 (39.0)
<b>Trunk Extension</b>			
30	274.0 (97.0)	278.0 (82.1)	266.0 (85.4)
60	255.0 (89.0)	263.3 (84.0)	257.0 (83.4)
90	246.3 (79.0)	250.3 (81.2)	245.0 (73.3)
120	227.4 (67.0)	225.0 (70.0)	225.3 (77.4)

\*p=.008, \*\*p=.03, \*\*\*p=.02

**Table 3.—Average power for trunk flexion/extension at 30°, 60°, 90°, and 120°/s (Ft-lb/s; Mean + SD).**

Speed (°/s)	LUMBAR / SACRAL SUPPORTS		
	Proflex	Experimental Belt	Control
<b>Trunk Flexion</b>			
30*	66.4 (21.0)	62.1 (18.4)	69.1 (20.0)
60	125.0 (33.0)	123.4 (36.3)	135.3 (29.0)
90	181.1 (48.0)	177.0 (50.0)	191.1 (44.2)
120	235.2 (61.3)	226.0 (62.0)	246.0 (56.0)
<b>Trunk Extension</b>			
30	94.2 (32.4)	96.0 (28.0)	92.0 (31.0)
60	180.4 (56.0)	183.0 (58.0)	173.0 (55.0)
90	257.1 (79.4)	263.0 (85.0)	257.0 (77.0)
120	318.0 (89.4)	315.0 (95.0)	316.0 (109.3)

\*p=.007

motions and testing speeds were predetermined by the Cybex testing protocol and considered inappropriate for manipulation by the investigators. Further, there were no hypotheses formulated to test for interactive effects, and no literature was available to support the possibilities that interactive effects would occur.

## Results

Trunk flexion forces were greater when subjects used no support device (control conditions) (Tables 1-3). There were no differences between conditions during trunk extension tests ( $F[2,18] = .65, p = .53$ ). At 30°/s ( $F[2,18] = 5.68, p = .01$ ), 90°/s ( $F[2,18] = 5.54, p = .01$ ), and 120°/s ( $F[2,18] = 3.63, p = .04$ ), subjects wearing the experimental belt and rigid abdominal pad typically produced lower peak torque than subjects wearing no support device (Scheffé post hoc,  $p < .05$ ). Peak torque at 60°/s ( $F[2,18] = 2.74, p = .09$ ) noted only marginal differences with subjects producing lower peak torques when wearing the experimental belt and rigid abdominal pad. At 90°/s, subjects using the experimental belt produced less peak torque than when wearing the Proflex device (Scheffé post hoc,  $p < .05$ ). No differences were noted in peak torque at 30°, 60°, and 120°/s when contrasting the Proflex with the experimental belt. At all of the testing speeds (30°/s ( $F[2,18] = 6.34, p = .008$ ), 60°/s ( $F[2,18] = 4.09, p = .03$ ), 90°/s ( $F[2,18] = 3.96, p = .03$ ), and 120°/s ( $F[2,18] = 4.86, p = .02$ ), subjects wearing the experimental belt produced lower measurements of total work than did the control condition of no support device (Scheffé post hoc,  $p < .05$ ). At 30°/s (Scheffé post hoc,  $p < .05$ ), total work was lower for the experimental belt than for the Proflex. No differences were noted in total work at 60°, 90°, and 120°/s when contrasting the Proflex with the experimental belt. Average power was less at 30°/s ( $F[2,18] = 6.46, p = .007$ ) for subjects wearing the experimental belt than either the control or the Proflex device (Scheffé, post hoc,  $p < .05$ ). No differences were noted in average power at 60°/s ( $F[2,18] = .81, p = .45$ ), 90°/s ( $F[2,18] = .50, p = .61$ ), and 120°/s ( $F[2,18] = .60, p = .55$ ) between

testing conditions.

## Discussion

The Proflex device remains controversial. Some researchers claim that the semirigid Proflex device improves lifting ability.<sup>9,20</sup> One researcher, using a biomechanical model, concluded that the Proflex affects lifting posture by inhibiting trunk flexion, thereby reducing trunk compressive and shear forces.<sup>20</sup> Another study used electromyography (EMG) to indicate stress, recording functional changes in the musculature surrounding the first and fifth lumbar regions.<sup>9</sup> Because of their design, these studies do not demonstrate definitively that the Proflex improves lifting ability.

Our findings are consistent with those of Amendola,<sup>1</sup> who studied trunk flexion and extension with resistance by testing the Proflex, air belt, combined Proflex and air belt, and control (no support). Our results also support observations that the rib cage needs increased rigidity, while the abdominal wall needs increased compression during forward bending and extending, as in weight lifting.<sup>14</sup> Other researchers also noted reduced EMG activity of the rectus abdominis and abdominal obliques when the trunk was supported by a corset during resistive trunk flexion/extension movement.<sup>14</sup> Use of a supportive device significantly increased intra-abdominal pressure, but when the trunk was not supported, this pressure was reduced.<sup>14</sup> These studies seem to support the results in this and previous related studies.<sup>18,19</sup> We conclude that trunk flexion forces increase when supportive devices are not used. We recorded higher mean values during trunk flexion activity for peak torque and total work in both the semirigid Proflex and unsupported control conditions.

While we did not record EMG or intra-abdominal pressure, our study of the forces generated at various speeds of isokinetic contraction helps to confirm earlier studies.<sup>1,14</sup> It appears that a rigid or semirigid trunk supportive device reduces trunk muscle activity.

Perhaps this finding accounts for the lower values we obtained when we con-

trasted supported and unsupported trunk flexion at various speeds of isokinetic resistance. When our subjects used the experimental and Proflex back support systems, peak torque, total work and average power measurements were consistently lower than measurements of the control group. Contrasted with the control group, the use of the rigid experimental belt/pad support significantly reduced isokinetic force. Contrasted with the semirigid Proflex support, the experimental belt marginally reduced isokinetic force. In both cases, the values for the rigid experimental belt support were consistently lower.

Our results indicate that a rigid belt/pad support tends to diminish trunk force. The clinician can use this research to delineate potential advantages for athletes requiring lumbar/sacral support during trunk movement, as suggested in weight lifting. We recommend further research measuring intra-abdominal pressure and EMG parameters to study the effects of these lumbar/sacral supports.

## Acknowledgment

We appreciate the assistance of the Physical Therapy staff of Sentara Leigh Hospital, Physical Therapy Specialty Center, Norfolk, Virginia, in the investigation.

## References

1. Amendola A. *An Investigation of the Effects of External Supports on Manual Lifting*. College Station, Tex: Texas A & M University; 1989. Dissertation.
2. Bartelink DL. The role of abdominal pressure in relieving the pressure on the lumbar intervertebral discs. *J Bone Joint Surg*. 1957;39B:718-725.
3. Chaffin DB. Computerized biomechanical models: development of and use in studying gross body actions. *J Biomech*. 1967;212:429-441.
4. Davies GJ, Gould JA. Trunk testing using a prototype Cybex II isokinetic dynamometer stabilization system. *J Orthop Sports Phys Ther*. 1982;3:164-170.
5. Garg A, Herrin GD. Stoop or squat: a biomechanical and metabolic evaluation. *AIEE Transactions*. 1979;11:293-302.
6. Gould JA, Davies GJ. Orthopaedic and sport rehabilitation concepts. In: Gould JA, Davies GJ, eds. *Orthopaedic Sports Physical Therapy*. St. Louis, Mo: The CV Mosby Company; 1985:190-194.
7. Harman EA, Rosenstein RM, Frykman PN, Nigro GA. Effects of a belt on intra-abdominal pressure during weight lifting. *Med Sci Sports Exerc*. 1989;21:186-190.
8. Harman EP, Frykman B, Clagett B, Kraemer W. Intra-abdominal and intra-thoracic pressures during lifting and jumping. *Med Sci Sports Exerc*. 1988;20:195-201.
9. Jones L, McEnvoy P, Mills S, Nash R, Perkins J. The effects of a restrictive device on stress in the lumbar region of the back. Presented to the Ergodyne Equip-

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ment Corporation; October, 1985; St. Paul, Minn.

10. Langrana NA, Lee CK. Isokinetic evaluation of trunk muscles. *Spine*. 1984;9:171-175.
11. Langrana NA, Lee CK, Alexander H, Mayott CW. Quantitative assessment of back strength using isokinetic testing. *Spine*. 1984; 9:287-290.
12. Lindh M. Biomechanics of the lumbar spine. In: Nordin M, Frankel VH, eds. *Basic Biomechanics of the Musculoskeletal System*. 2nd ed. Philadelphia, Pa: Lea and Febiger; 1989:183-207.
13. Marras WS, King AI, Joynt RL. Measurements of loads on the lumbar spine under isometric and isokinetic conditions. *Spine*. 1984;9:176-187.
14. Morris JM, Lucas DB, Bresler B. Role of the trunk instability of the spine. *J Bone Joint Surg*. 1961;43A:327-350.
15. Timm K. Isokinetic lifting simulation: a normative data study. *J Orthop Sports Phys Ther*. 1988;10:156-166.
16. Troup JDG. Relation of lumbar spine disorders to heavy manual work lifting. *Lancet*. 1965;1:857-861.
17. Troup JDG, Lekinsen TPG, Stalhammar HR, Kurinka IAA. A comparison of intra-abdominal pressure increase, hip torque, and lumbar vertebral compression in different lifting techniques. *Human Factors*. 1983;25:517-525.
18. Woodhouse ML, Heinen JRK, Shall L, Bragg K. Isokinetic trunk rotation parameters of athletes utilizing lumbar/sacral supports. *Athletic Training, JNATA*. 1990;25:240-243.
19. Woodhouse ML, Heinen JRK, Shall L, Bragg K. Selected isokinetic lifting parameters of adult male athletes utilizing lumbar/sacral supports. *J Orthop Sports Phys Ther*. 1990;11:467-473.
20. Wu C. The effects of the Compvest back support in manual lifting tasks. Auburn, Ala: Auburn University; 1985. Thesis.

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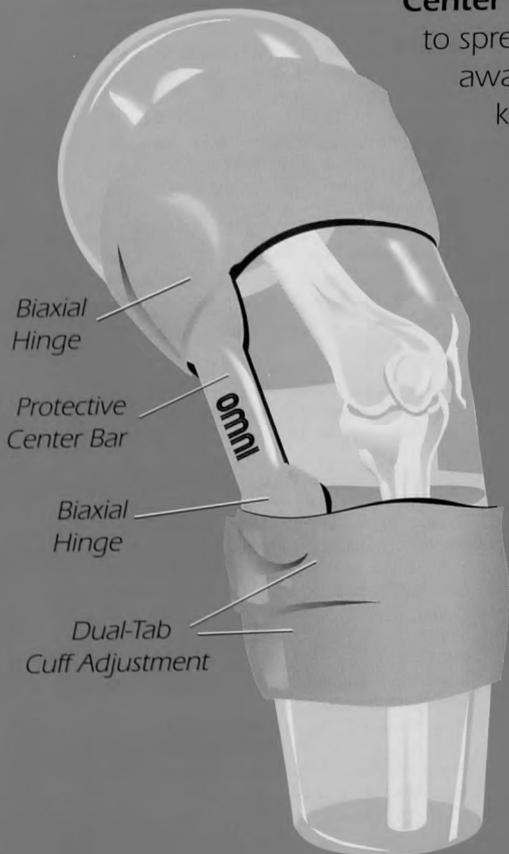
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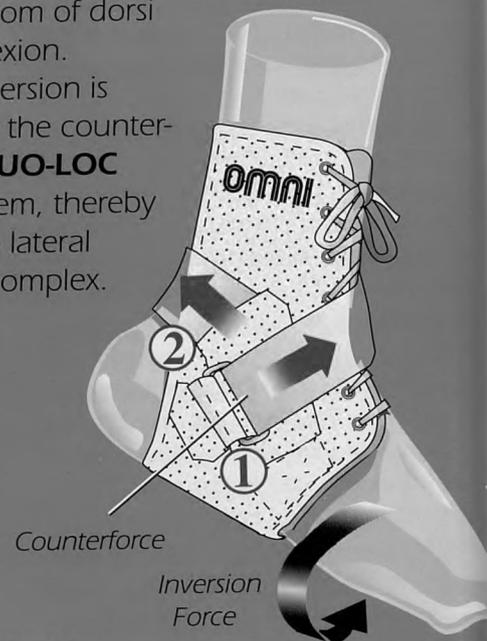


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**Abstract:** We attempted to determine if the selected lateral prophylactic knee braces (ie, Anderson Knee Stabler-101W, Don Joy-PKG and McDavid Knee Guard) were effective at stabilizing the medial collateral ligament against valgus loading to the knee joint. We tested 23 volunteer subjects under each of three braced conditions, plus a nonbraced condition. Applying stress to the lower leg of the subjects, we measured and recorded the linear displacement of the tibia in abduction and/or adduction. We analyzed the data, using a repeated measures ANOVA. There were no differences between the bracing conditions. We concluded that the three knee braces were not effective at stabilizing the knee joint from a static valgus force.

# An In Vitro Biomechanical Study of The Static Stabilizing Effect of Lateral Prophylactic Knee Bracing on Medial Stability

George F. Salvaterra, MA  
MinQi Wang, PhD  
C.A. Morehouse, PhD  
William E. Buckley, PhD

**T**he knee joint often is described as one of the most complex joints of the human body.<sup>16</sup> It also is injured frequently in contact and noncontact sport activities. This is because the knee is subjected to tremendous shear and torsional forces and loads during normal athletic activities. Efforts to reduce the number of knee injuries in college football have centered around the reduction of medial collateral ligament injuries.<sup>19</sup> This has led physicians, athletic trainers, and manufacturers to develop prophylactic lateral bracing to protect this vulnerable joint. Decreasing the incidence, severity, and duration of these injuries without impairing performance should be the goal of every prophylactic brace manufacturer.

In the past several years, considerable interest has focused on developing

lateral prophylactic knee braces which will prevent or reduce the severity of knee injuries. However, there is little empirical in vitro research available to support the manufacturers' anecdotal claims that lateral knee braces can reduce the incidence of knee injuries. In fact, the Sports Medicine Committee of the American Academy of Orthopedic Surgeons has stated its reservations regarding the effectiveness of lateral prophylactic knee braces and the need for further biomechanical and epidemiological studies to determine their efficacy.<sup>1</sup> In this study, we attempted to determine if there was a difference in the stabilizing effects of three knee braces (ie, Anderson Knee Stabler-101W, Don Joy-PKG and McDavid Knee Guard) and nonbraced conditions.

## Methods

We randomly selected 23 subjects from a sample of volunteers participating in the intramural football program at The Pennsylvania State University. The subjects selected had to meet three inclusion criteria: 1) at least two years of high school varsity football experience; 2) no previous experience of knee injury; and 3) no previous ex-

perience wearing a knee brace. The sample selected from the above criteria would resemble the characteristics of the population that currently wears the lateral prophylactic knee braces—physically active young adults who participate in contact and noncontact sports and have no history of knee instability. The lack of brace-wearing experience decreased the chance of subject bias concerning the use of bracing. Subjects received a complete written and verbal explanation of the study and gave informed consent. The University Human Subjects Committee approved the study.

We adopted a repeated measures design and tested each subject under each of the four conditions. Thus, subjects served as their own controls. We randomized the four conditions to control testing order effect. In order to establish the test-retest reliability of the measurements, we randomly selected 10 subjects and retested them using the same protocol 7 days after the testing.

A table base, 67 inches long, 30 inches wide and 30 inches high, was constructed of angle iron and covered with plywood and formica.<sup>15</sup> The table is a prototype of the model described by Sprague and Asprey<sup>24</sup> (Fig 1). We set

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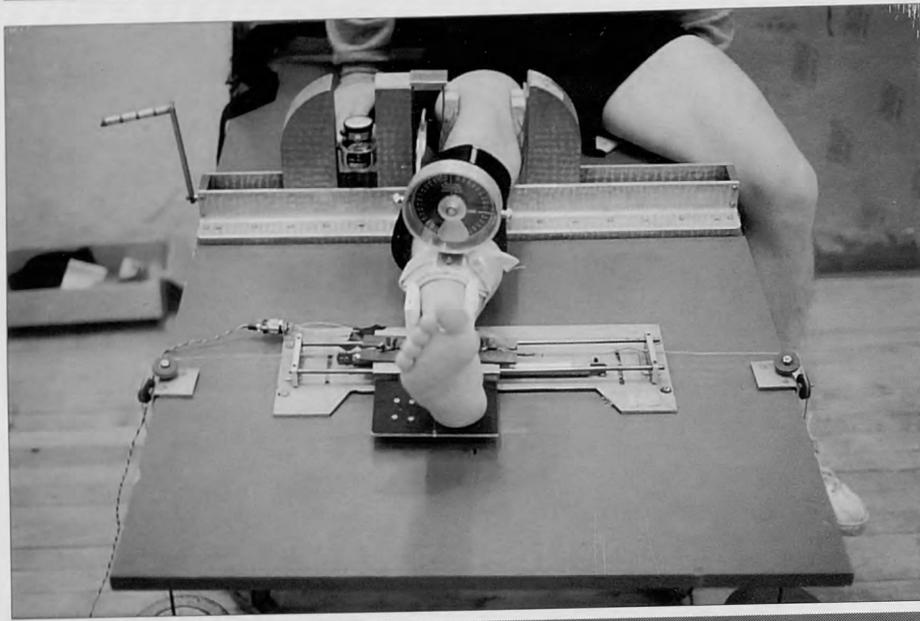


Fig 1.—A subject is being tested.

the backrest at an angle of  $80^\circ$  with the table top. We designed the knee vise and machined it so that a controlled amount of force could be applied to the epicondyles of the femur. The track, 2 inches deep, 2 inches wide, and 30 inches long, was fabricated from block aluminum. A 30-inch shaft was threaded partially and inserted through three solid aluminum blocks. A 2-inch wide, 2-inch long, and 8-inch high U-shaped adapter was fitted to either block of the vise. This enabled the brace to be placed inside the blocks of the knee vise, yet was free of compression forces, while the condyles of the femur were held in position. One quarter-inch foam rubber padded the internal surfaces of the adapter holding the knee. A carriage assembly, which consisted of a 6- x 3.5-inch metal plate supported the heel of the subject's leg in the testing position. An appropriate length of 1/16-inch aircraft cable was attached to each side of the carriage assembly. These cables extended over frictionless pulleys mounted on either side of the table opposite the center of the carriage assembly. Weight pans, each of which held approximately 117.7 N, were attached to the free ends of the cable.

We attached two linear potentiometers to the carriage assembly so that when stress was applied to the lower leg, linear displacement of the tibia in abduction and/or adduction was

recorded as a change in voltage output from a voltmeter. This linear displacement was proportional to the tangent of the angle of displacement and, therefore, permitted the calculation of this angle. Approximately  $16^\circ$  of deviation in either adduction or abduction could be measured with this arrangement. Prior to obtaining measurements in any evaluation session, we calibrated the instrument to ensure that voltage outputs were accurate. We conducted further calibrations periodically during the testing, as well as before and after each testing session.

We tested subjects at  $10^\circ$  of knee flexion. This position limited the torsional laxity function of the knee,<sup>13</sup> which increases rapidly as the knee flexes past  $10^\circ$ . This position allowed the instrument to evaluate the medial collateral ligament without the knee being locked in terminal extension.<sup>11</sup> We conducted three trials for each of the four conditions (three braces plus the control) and used the mean for subsequent analysis.

We marked each subject's right and left knees with a permanent marker on the joint line. This helped minimize positioning error. The testing procedure began after a warm-up, which consisted of 20 jumping jacks, 20 half-squats, 2 minutes of rope jumping, and a 4- x 20-yard carioca. The subject then sat on the table with the extremity

to be tested extended through the knee vise, and the opposite leg placed over the side of the table with the foot hooked on a steel stud. The marked joint line was aligned with the near edge of the medial block and the U-shaped extension of lateral block which held the distal end of the femur. After general alignment of the subject, we then applied a randomly selected brace, following the exact specifications of the manufacturer. We told the subject to relax against the backrest and fastened an automobile seat belt about the pelvic region. The vise then was closed so that it exerted a force of 176.58 N on the lateral and medial condyle of the femur. This was essential to avoid femoral rotation, a source of considerable error in valgus knee testing.<sup>2,12</sup> We asked the subject if there was any discomfort to avoid possible irritation of the iliotibial band.<sup>15</sup> The weight of the lower leg was supported directly on the carriage assembly and its heel was supported on a platform with two adjustable side clamps tightened over the tibia and fibula. This design stressed the medial collateral ligament in an open kinetic chain and might be considered a limitation because most injuries occur in a closed kinetic chain, with the foot fixed and the knee abducted and externally rotated.

We marked the knee, tibia, and fibula at the sight of their positioning on the testing device. This helped minimize repositioning error between treatments and increased reliability. We gradually removed 12 kilograms of weight in five, 2-kg increments, and then two, 1-kg increments from the medial side to abduct the tibia for 5 seconds. We adopted a force of 117.7 N to avoid the inaccuracy of measurement that uncomfortably strong forces might cause.<sup>5,10,15</sup> We instructed all subjects to relax the musculature of the test limb. Assumed relaxation of thigh musculature has been shown not to affect the degree of abduction and adduction of the knee and results in reliable testing.<sup>5</sup> A trial load took place to familiarize the individual with the test procedures and ensure that muscle relaxation took place during the test.

We firmly fixed a Leighton flexometer to the lower leg with a velcro

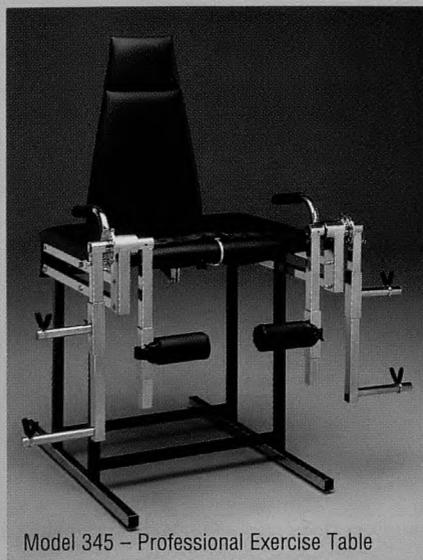
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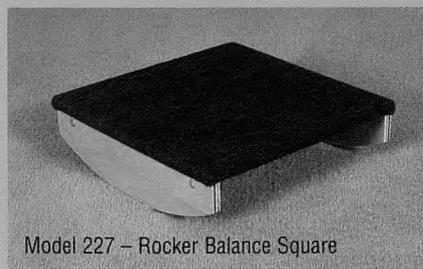
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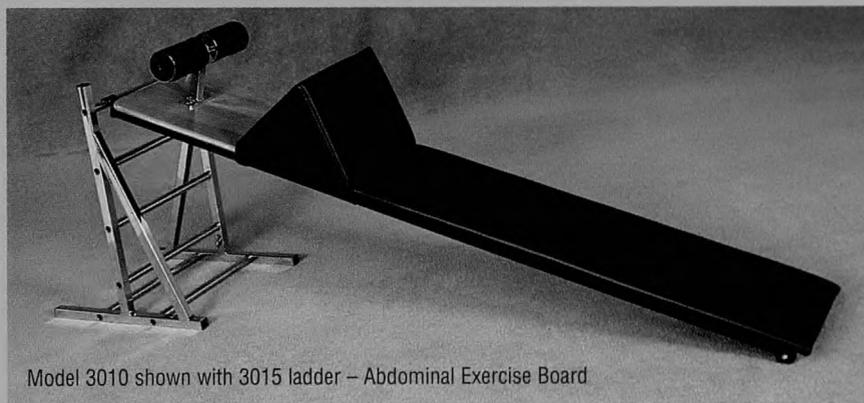
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strap to monitor possible rotation of the leg at the hip joint. The number of degrees of rotation could be monitored, regardless of the degree of flexion the knee assumed. Excessive rotation might result in greater voltage output of the potentiometer. This would indicate a larger lateral deviation than actually would be occurring. If more than one degree of rotation occurred as indicated by the flexometer, we repositioned the knee in the vise, and abduction resumed.

Data analysis included calculations of the means of all brace and nonbrace scores for each subject. We examined the differences between the brace conditions, using a repeated measures analysis of variance (ANOVA). In addition, we computed the Pearson product moment correlation coefficients to examine the test-retest

reliability of the knee abduction measures.

## Results

The descriptive statistics of valgus angle of knee joint are presented in Table 1. There were no differences between the bracing conditions ( $F[3,135]=0.93, p=.43$ ). Therefore, the valgus angle of knee joint opening did not reduce as a result of wearing any of the three braces tested.

We examined the reliability of the test by evaluating the test and retest measurements of knee abduction. We computed the Pearson product moment correlation coefficients between the test and retest scores for each brace and nonbrace conditions (see Table 2). These coefficients, ranging from .80 to .86, suggest that the testing instrument and testing protocol were reliable

methods from the test date to the retest date (1-week interval).

## Discussion

The three knee braces were not effective at stabilizing the knee joint from a static valgus force of 117.7 N. These in vitro results seem to be consistent with findings from previous cadaver studies.<sup>3,4,17</sup> The load used in this study was considerably lower than one that would induce injury. However, Paulos et al<sup>17</sup> pointed out four possible reasons why these braces were not effective at stabilizing the knee joint. First, a preload effect was found on the medial collateral ligament secondary to poor fit. Second, a shift in center axis occurred, which resulted in a change of loading patterns for the cruciate ligaments. Third, a reduction of effectiveness is a potential liability with brace slippage. And, fourth, at the time of brace hinge contact to the joint line, a three-point fulcrum system is created, with the potential of increased forces bearing directly through the medial joint line. However, Pipes<sup>18</sup> reviewed these studies and raised questions about the results and their conclusions. He believed that the data refuted the concept of preloading and tended to support the efficacy of lateral knee bracing. It was also his contention that any conclusions on medial collateral ligament preloading, positive or negative, could not be drawn from these studies because of severe design limitations.

The prophylactic knee braces have two general features which make it possible to group them into two types: 1) lateral bars with either a single axis, dual axes, or polycentric hinges; and 2) plastic shells that encircle the thigh and calf and have polycentric hinges.<sup>1</sup> The Sports Medicine Committee of the American Academy of Orthopedic Surgeons<sup>1</sup> recommended seven characteristics of an ideal prophylactic knee brace. It should:

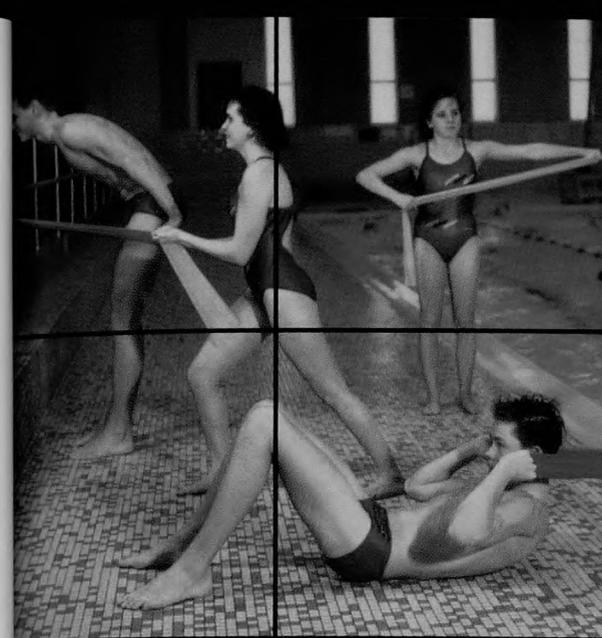
1. supplement the stiffness of the knee to reduce injury-producing loads from both contact and noncontact stresses;
2. not interfere with normal function;
3. not increase the risk of injury elsewhere in the lower extremities;

**Table 1.—Summary of Means, Standard Deviations and Ranges of Valgus Angles of Knee Joint Opening Deviation in Degrees (n=23, knees=46).**

Brace	$\bar{X}$ (degrees)	SD	Range
Anderson Knee Stabler-101W	7.40	1.47	4.71--10.17
Don Joy-PKG	7.39	1.30	4.19--10.55
McDavid Knee Guard	7.37	1.27	4.78-- 9.91
No Brace	7.55	1.70	3.85--11.54

**Table 2.—Correlation Coefficients of Valgus Between Test and Retest (n=10, knees=20).**

Brace	r	p
Anderson Knee Stabler-101W	.8228	.0001
Don Joy-PKG	.8245	.0001
McDavid Knee Guard	.8575	.0001
No Brace	.7967	.0001



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There is limited laboratory research evaluating the materials and biomechanics of lateral prophylactic knee braces. The studies that have been conducted typically have used cadaver subjects. Researchers designed these studies to create conditions that would allow the braces to function optimally.<sup>3,4,17</sup> This was accomplished by rigidly fixing the knees in position and applying forces perpendicular to the joint line and the brace. Results showed that the braces are not rigid enough to prevent joint line opening. For example, an in vivo biomechanical study of the static stabilizing effects of prophylactic knee braces indicated that, with a fixed foot, abduction and external rotated stress on the knee joint were not reduced by prophylactic knee bracing.<sup>3</sup>

We selected the braces in this study on the basis of availability, and we believe that they represent a major portion of the types of lateral prophylactic knee braces currently on the market. The Anderson Knee Stabler-101W has a dual-axes hinge with hyperextension stops. It is made of steel, with contour flanges and polyethylene cuffs, and is suspended by a thigh and calf strap for support. The Don Joy-PKG is a polycentric hinge (biaxial hinge) brace with a hyperextension stop and is made of aluminum alloy in a leaf spring design with polyethylene cuffs. It is suspended by neoprene thigh and calf straps and a velcro strap that stabilizes the brace above the calf. The McDavid Knee Guard is a single-axis hinge (uniaxial hinge) with a hyperextension stop made of lexan and is suspended by neoprene calf and thigh sleeves and elastic support straps.

Results of epidemiological studies to determine the effects of lateral

prophylactic knee braces are also controversial. A number of studies<sup>2,6-9,14,21,23,25</sup> reported trends of knee braces toward reducing the incidence of serious medial collateral ligament injuries. However, some of these reports did not determine any significant differences, and some are purely anecdotal.<sup>2,7,23</sup> The effects of prophylactic braces on various performance parameters are also conflicting. Some findings showed a significant reduction in forward running speed,<sup>20</sup> while others indicated no effect wearing prophylactic knee braces. The contradictory results from both epidemiological and performance studies might be a result of the fact that these studies might have adopted different types of prophylactic knee braces, different levels of play, and different subjects with and without brace-wearing experience, etc. Prentice and Toriscelli<sup>20</sup> suggested that an adjustment period might be necessary after wearing a knee brace to reduce any adverse effects on performance.

In future studies, it is important that researchers standardize the testing protocols and control for various factors systematically. Until then, the status quo regarding knee braces is, as Ryan<sup>22</sup> stated, "It was clear that we are not sure what knee braces are designed for, and we are not sure if they prevent knee injuries. Most of us are willing to continue using them on the assumption that we are doing no harm. It is also clear that further clinical and biomechanical research is necessary before we have a clear answer."

## References

1. American Academy of Orthopaedic Surgeons. *Knee Braces*. Seminar Report; 1984; Chicago, Ill.
2. Anderson G, Zeman S, Rosenfeld R. The Anderson knee stabler. *Phys Sportsmed*. June 1979;7:125-127.
3. Baker BE, Van Hanswyk E, Boqosian S, Werner FW, Murphy D. A biomechanical study of the static stabilizing effect of knee braces on medial stability. *Am J Sports Med*. 1987;15:566-570.
4. France EP, Paulos LE, Jayarman G, Rosenberg T. The biomechanics of lateral knee bracing. Part II: impact response of the braced knee. *Am J Sports Med*. 1987;15:430-438.
5. Goldfuss AJ, Morehouse CA. Effect of muscular tension on knee stability. *Med Sci Sports Exerc*. 1973;5:267-271.
6. Grace TG, Skipper BJ, Newberry JC. Prophylactic knee braces and injury to the lower extremity. *J Bone Joint Surg*. 1986;14:262-266.
7. Hansen B, Ward J, Bichl R. The preventative use of the Anderson knee stabler. *Phys Sportsmed*. September 1985;13:75-81.
8. Haupt H, Revere G, Yates C. Do knee stabilizers help prevent knee injuries in college football—a retrospective study. *Med Sci Sports Exerc*. 1985;17:254. Abstract.
9. Hewson G, Wang J, Mardini R. Prophylactic knee bracing in college football. Presented at American Orthopaedic Society for Sportsmedicine; July 1, 1985; Nashville, Tenn.
10. Jacobsen K. Stress radiographical measurement of the anteroposterior, medial and lateral stability of the knee joint. *Acta Orthop Scand*. 1976;47:335-344.
11. Kneedy JD, Fooler PJ. Medial and anterior instability of the knee. *J Bone Joint Surg*. 1971;53A:1257-1270.
12. Markolf KL, Graff-Radford A, Amstutz HC. In vivo knee stability: a quantitative assessment using an instrumented clinical testing apparatus. *J Bone Joint Surg*. 1978;60A:664-674.
13. Markolf KL, Mensch JS, Amstutz HC. Stiffness and laxity of the knee—the contribution of supporting structures—in vitro study. *J Bone Joint Surg*. 1976;58:583-593.
14. McKelvie R. *The Effectiveness of Prophylactic Knee Bracing*. Bowling Green, Ohio: Bowling Green State University; 1985. Thesis.
15. Morehouse CA. *Evaluation of Knee Abduction and Adduction and the Effects of Selected Exercise Programs on Knee Stability and Its Relationship to Knee Injuries in College Football*. Washington, DC: Department of Health Education and Welfare; 1970.
16. Norken CC, Levangie PK. *Joint Structure and Function*. Philadelphia, Pa: Davis Company; 1988:295.
17. Paulos L, France P, Rosenberg T. Valgus knee injuries and preventive bracing: a biomechanical study. Presented at the American Orthopaedic Society for Sportsmedicine; July 1, 1985; Nashville, Tenn.
18. Pipes TV. *Protective Knee Bracing: Assessing the Preloading Concept*. (A review of the study: "Valgus knee injuries and preventative bracing: a biomechanical study.") Placerville, Calif: National Institute of Human Fitness; 1985:1-9.
19. Powell JW. Pattern of knee injuries associated with college football 1975-1982. *Athletic Training*. 1985;20:104-109.
20. Prentice WE, Toriscelli T. The effects of lateral knee stabilizing braces in running speed and agility. *Athletic Training*. 1986;21:112-113.
21. Quillion W, Simms R, Cooper J. Knee bracing in preventing injuries in high school football. *Intern Pediatr*. 1987;2:255-256.
22. Ryan A. Knee braces used to prevent injuries in football, a round table. *Phys Sportsmed*. April 1986;14:108-118.
23. Rovere GD, Haupt HA, Yates CS. Prophylactic knee bracing in college football. *Am J Sports Med*. 1987;15:111-116.
24. Sprague RB, Asprey GM. Photographic method for measuring knee stability. *Am J Phys Ther Assoc*. 1965;45:1055-1058.
25. Teitz CC, Hermanson BK, Kronmal RA, Diehr PH. Evaluation of the use of braces to prevent injury to the knee in college football players. *J Bone Joint Surg*. 1987;69A:2-9.

# Electromyographic Analysis of Four Popular Abdominal Exercises

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William B. Wehrenberg, PhD

**Abstract:** This study was designed to evaluate the effects of four specific sit-up exercises on muscular activity of the rectus abdominis. Pairs of surface electrodes were placed unilaterally on four quadrants of the rectus abdominis, delimited by tendinous inscriptions, in four male subjects. Electromyographic (EMG) recordings were taken while the subjects performed four different abdominal exercises. Each abdominal exercise was hypothesized to have a specific effect on one of the four quadrants of the rectus abdominis. The four exercises analyzed were: 1) long lying crunch, 2) bent knee crunch, 3) leg raise, and 4) vertical leg crunch. Analysis of the standardized EMG recordings demonstrated no significant differences in the mean muscle activity between the four different quadrants, in the mean muscle activity between the four different exercises, and in interactions between the exercises and the quadrants of the rectus abdominis. We conclude that none of the four ab-

dominal exercises studied are specific for strengthening individual muscle quadrants of the rectus abdominis.

In an attempt to enhance athletic performance, scientists have studied the relationship between the effects of specific exercises, muscle activity, and muscular development. Several investigators have used electromyography (EMG) in an attempt to describe and evaluate the activity of abdominal muscles during different forms of exercise. In these studies, increased electrical activity served as an indicator of increased muscle activity.<sup>4,7,14,21</sup> To date, EMG evaluation of the rectus abdominis muscle has been limited to recording the activity of the upper half (lateral to the linea alba and superior to the umbilicus) and the lower half (ipsilateral to the upper half and below the umbilicus) of the muscle,<sup>2,3,6,10,17</sup> or recordings of the whole muscle.<sup>8,12</sup> The results of these studies have suggested that certain sit-ups affect the electrical activity of the upper half differently than the lower half.

EMG studies have not been undertaken to describe and evaluate the activity of the four quadrants of the rectus abdominis, delimited by the tendinous inscriptions perpendicular to the linea alba (lineae transversae). These tendinous inscriptions divide the upper half into three quadrants, while the lower half remains intact.<sup>9</sup> Analysis of muscle

activity in the various quadrants is necessary to test the hypothesis put forth by trainers, conditioning coaches, and popular fitness and conditioning publications that specific abdominal exercises develop specific quadrants of the rectus abdominis.<sup>13,16,20,22</sup> The purpose of the present study was to determine the electrical (muscle) activity of the four quadrants of the rectus abdominis during four different sit-up exercises.

## Materials and Methods

The study was reviewed and approved by the University of Wisconsin-Milwaukee Internal Review Board for the use of human subjects. Four male athletes of similar physical ability and anthropometric characteristics performed four different forms of abdominal exercises. Subjects ranged from 19 to 37 years of age and weighed from 76 kg (167 lbs) to 92 kg (202 lbs). Height ranged from 173 cm (69 in) to 190 cm (76 in).

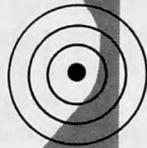
The abdomen of each subject was shaved and cleaned with alcohol prior to electrode placement. We unilaterally placed pairs of surface electrodes on the four quadrants of the rectus abdominis (Fig 1). We placed the superior electrode of the first pair 3 cm superior to the first lateral tendinous inscription on the right side of the rectus abdominis. We placed a second electrode 2 cm below the superior electrode. This electrode pair measured EMG activity in quadrant 1 or the upper quadrant of the rectus abdominis. Placement of the pairs of electrodes for the three lower quadrants was standardized by palpating the tendinous inscriptions for each quadrant and placing a pair of surface electrodes equidistant between each tendinous inscription (Fig 1). We took unilateral recordings because it has been reported that electrical activity within the rectus abdominis muscle is bilaterally equal.<sup>6</sup> The muscle quadrants were labeled: 1) upper quadrant, 2) upper middle quadrant, 3) lower middle quadrant, and 4) lower quadrant.

We performed electromyographic recordings using a DAS416 multichannel digital data recorder, interfaced with an IBM-compatible personal computer. Software for signal acquisition and data

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processing was developed by Technology Resource, Inc (Algonquin, Ill). Baseline recordings of the subjects at rest demonstrated integrated electrical activity in the rectus abdominis of 0.15 mV. Therefore, an automatic trigger was established at 0.15 mV as the threshold for the onset of exercise activity. Recording time of each abdominal exercise was 3 seconds and was controlled by an automatic timer. We used four channels to obtain separate recordings from each of the four quadrants of the rectus abdominis. Figure 2 illustrates a typical EMG recording from the present study.

The four exercises analyzed were: 1) long lying crunch, 2) bent knee crunch, 3) leg raise and 4) vertical leg crunch (Fig 3). The long lying crunch has been proposed to exercise the upper quadrant of the rectus abdominis, the bent knee crunch the upper middle quadrant, the leg raise the lower middle quadrant, and the vertical leg crunch the lower quadrant.<sup>16,22</sup> The athletes were familiar with the four exercises. However, they did not engage in regular training sessions of these sit-ups. Exercises 1,2, and 4 were of the "shoulder lift" variety, similar to the form studied by Halpern and Bleck.<sup>8</sup> In these exercises, the subject raises the head and shoulders to a height sufficient to allow the inferior border of the scapula to break contact with the floor. Uniform range of motion for each subject during the long lying crunch (exercise 1) was ensured by using a restraining rod. For the bent knee crunch (exercise 2) and the vertical leg crunch (exercise 4), the range of motion was complete when the subject's elbows contacted the thighs. Exercise 3 was of the "leg lift" variety.

#### Execution of Exercise

In exercise 1, the long lying crunch, the subject started from the supine position and raised his torso from the exercise mat to a point where the sternum came in contact with the restraining device. Exercise 2, the bent knee crunch, was performed in the same manner as the long lying crunch, except that the lower legs were elevated by a standard exercise bench (51 cm in height), placing the subject's hips in 45° of flexion. The range of motion was

complete when the elbows contacted the thighs. In exercise 3, the supine leg raise, the subject raised his legs off the floor while in a supine position, until 90° of hip flexion was attained. The legs were then returned to the starting position. In exercise 4, the vertical leg

crunch, the legs were supported against a wall perpendicular to the floor, placing the hips at 90° of flexion. The subject raised the upper body to a point at which the elbows came in contact with the thighs. To control for varying EMGs as a result of variable contraction

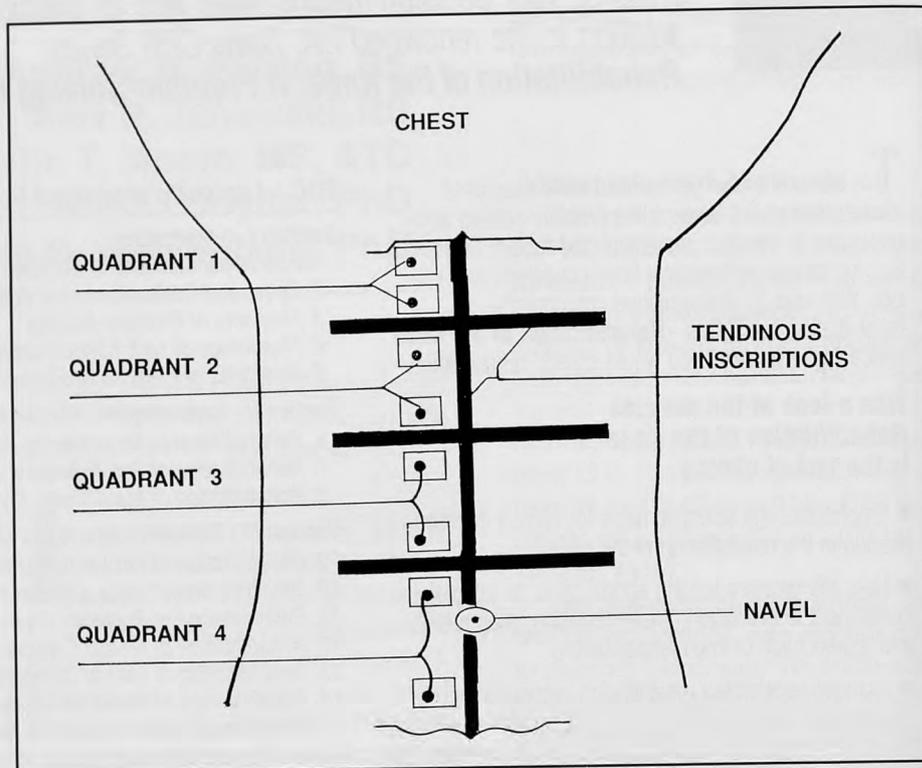


Fig 1.—Electrode placement on the four quadrants of the rectus abdominis using the tendinous inscriptions as anatomical landmarks.

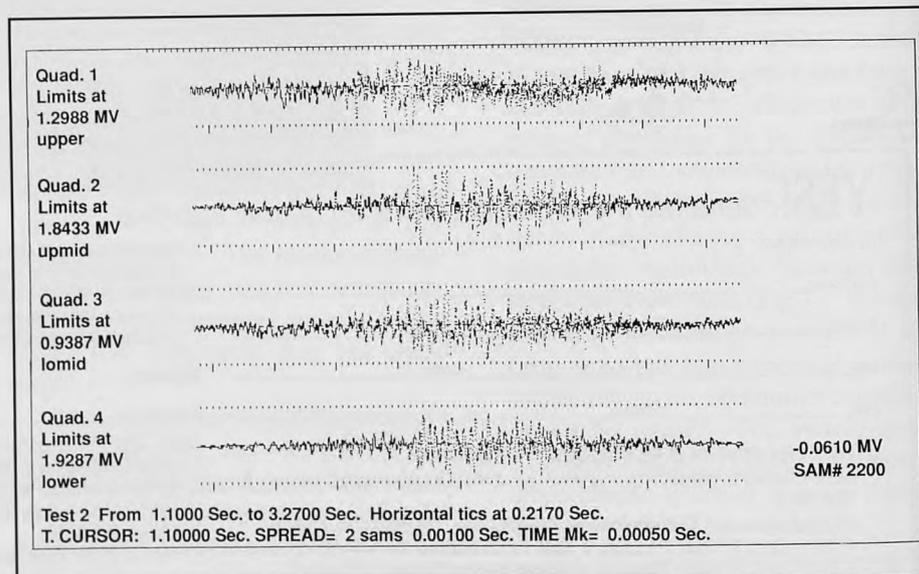
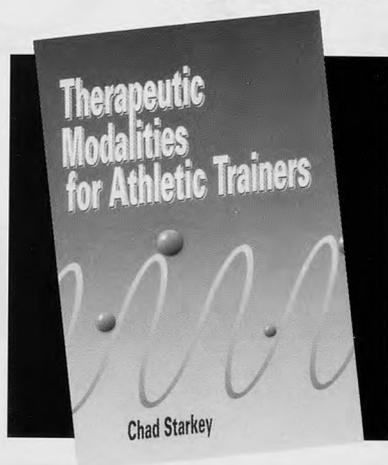


Fig 2.—A typical EMG for the four quadrants of the rectus abdominis in one subject performing sit-up exercise 1.

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velocity and duration of contraction, the sit-ups were performed to a specific cadence such that each exercise was completed in 3 seconds. This time interval was controlled by an automatic timer.

### Data Analysis

The integrated EMG depends on a variety of factors which vary across quadrants of the rectus abdominis and by subject (eg, electrode impedance, distance between electrodes, relationship of electrodes to motor points, amount and location of subcutaneous fat, etc).<sup>1</sup> To control for these factors, the data were standardized. This involved expressing the integrated EMG value for each electrode pair (quadrant) on each subject as a percentage of the highest integrated EMG for the four exercises within that quadrant. For example, in subject 1, the highest EMG value for quadrant 1 was 0.234 mV during exercise 3, while the EMG for quadrant 1 during exercise 2 was 0.189 mV. Therefore, the standardized score in subject 1 for quadrant 1, exercise 3 is 100%, while in quadrant 1, exercise 2, it is 81%. Standardized data obtained during the four abdominal exercises were analyzed using a two-factor ANOVA (exercise by quadrant). The treatment effects represented repeated measures in the same subject. The ANOVA was adjusted for this as described by Winer.<sup>19</sup> Differences were tested at  $p < .05$  level of significance. All data are expressed as mean  $\pm$  SEM.

### Results

Regardless of the exercise, each of the four quadrants demonstrated similar muscle activity as reflected by standardized EMG recordings ( $F[3,48]=1.0$ ,  $p=0.38$ ; Fig 4). Likewise, regardless of the quadrant, each of the four exercises elicited similar muscle activity ( $F[3,48]=1.26$ ,  $p=0.30$ ).

There were no significant interactions between the four abdominal exercises and the muscle activity of the four quadrants of the rectus abdominis ( $F[9,48]=0.86$ ,  $p=0.86$ ). The fact that spillover or cross talk from other muscles is minimal in the rectus abdominis<sup>5</sup> leads us to conclude that the

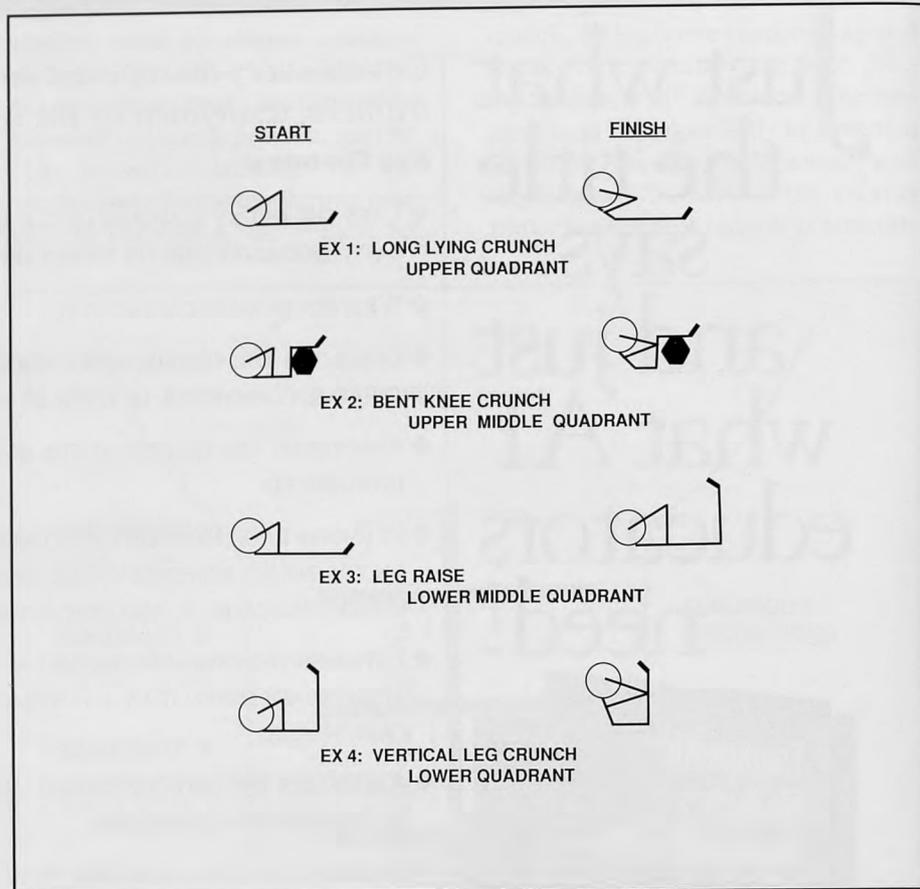


Fig 3.—Diagrammatic illustration of the execution of the four sit-up exercises studied and the hypothesized quadrant of muscle activation.

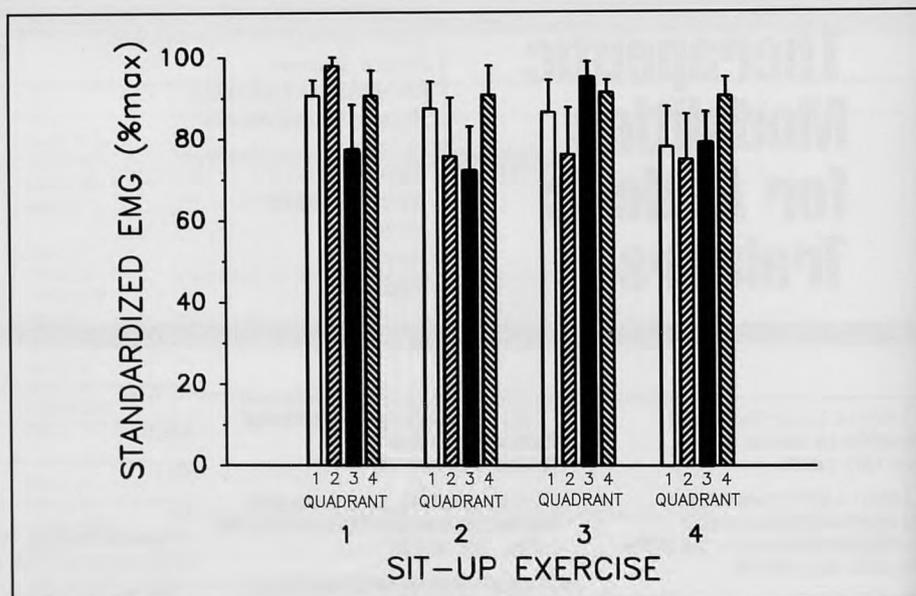


Figure 4.—Standardized mean electrical activity for the four quadrants within each sit-up exercise. Standardization of data is explained in the text. Error bars represent SEM. There were no significant main treatment effects or interactions between exercises and quadrants.

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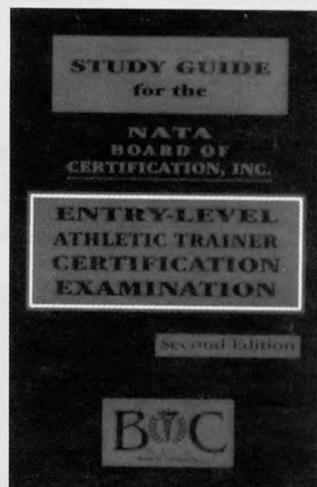
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exercises studied did not specifically increase the muscle activity in a given quadrant.

## Discussion

Popular fitness publications have suggested that specific abdominal exercises will develop specific quadrants of the rectus abdominis and that a regimen to increase the strength of the rectus abdominis should include several abdominal exercises. If this proposal is correct, then each specific exercise should elicit increased muscle activity, measured by EMG, in the specific target quadrant.<sup>14</sup> Our data demonstrate that for the four abdominal exercises studied, the standardized muscle activity in each quadrant was not significantly different, regardless of the exercise. For example, exercise 1, the long lying crunch, hypothesized to increase electrical activity in quadrant 1, did not significantly increase quadrant 1 standardized electrical activity more than any of the other exercises. In addition, the fact that no specific quadrant consistently exhibited more electrical activity than any other quadrant suggests that there is not a rank order in quadrant participation during any of the abdominal exercises.

Other investigators have noted differences in muscle activity between the upper and lower halves of the rectus abdominis while performing specific abdominal exercises.<sup>2,3,10,18</sup> This difference might result from the fact that the other studies divided the muscle in half and compared the electrical activity between the upper and lower halves, while we divided the muscle into its anatomical units<sup>9</sup> and compared the electrical activity across quadrants. Retrospective comparisons are not appropriate because the abdominis rectus was divided using different criteria.

Surface electrodes are a valid and widely used technique for estimating EMG activity.<sup>2,5,11,15,21</sup> An alternative would be the use of fine wire or needle electrodes placed directly into the muscle. Fine wire electrodes are used primarily to detect the electrical activity within muscles that are deep to the surface of the body or if significant spill-over or cross talk from other muscles is present. These are not of major concern for the rectus abdominis.<sup>5</sup> Furthermore, fine wire electrodes would interfere with the mechanical contraction of the muscle during the sit-up exercises.<sup>14</sup>

We conclude that the four abdominal exercises studied are not specific for strengthening individual muscle quadrants of the rectus abdominis. From a clinical or conditioning perspective, we suggest that one exercise would train the rectus abdominis as well as another, and a training regimen employing all the exercises is not necessarily needed. Yet, the possibility still exists that the evaluation of other abdominal exercises and the refinement of the exercises used in the present study might lead to identification of appropriate exercises to strengthen individual quadrants of the rectus abdominis.

## Acknowledgements

We thank Dr. B. Hart for assistance with EMG readings, and D. Priest of Technology Resource Inc, Milwaukee, WI, for technical assistance in performing this experiment. Research supported by NIH award K04 DK01874 to WBW.

## References

1. Basmajian JV, DeLuca CJ. *Muscles Alive: Their Functions Revealed by Electromyography*. 5th ed. Baltimore, Md: Williams & Wilkins; 1985:9-64.
2. Ekholm J, Arborelius U, Fahlcrantz A, Larsson A, Mattsson G. Activation of abdominal muscles

during some physiotherapeutic exercises. *Scand J Rehabil Med*. 1979;11:75-84.

3. Flint MM. Abdominal muscle involvement during the performance of various forms of sit-up exercise. *Am J Phys Med*. 1965;44:224-234.
4. Flint MM, Guggell J. Electromyographic study of abdominal muscular activity during exercise. *Res Q*. 1965;36:29-37.
5. Floyd WF, Silver PHS. Electromyographic study of patterns of activity of the anterior abdominal wall muscles in man. *J Anat*. 1950;84:132-145.
6. Furlani J, Bankoff AD. Electromyographic analysis of the rectus abdominis and external oblique muscles during exercises in lateral decubence, sitting and kneeling positions. *Electromyogr Clin Neurophysiol*. 1987;27:265-272.
7. Godfrey KE, Kindig LE, Windell EJ. Electromyographic study of duration of muscle activity in sit-up variations. *Arch Phys Med Rehabil*. 1977;58:132-135.
8. Halpern AA, Bleck EE. Sit-up exercises: an electromyographic study. *Clin Orthop*. 1979;145:172-178.
9. Gray H. *Anatomy, Description and Surgery*. 15th ed. New York, NY: Gramercy Books; 1977:356-367.
10. Lipetz S, Gutin B. An electromyographic study of four abdominal exercises. *Med Sci Sports*. 1970;2:35-38.
11. Mayhew TP, Norton BJ, Sahrman SA. Electromyographic study of the relationship between hamstring and abdominal muscles during a unilateral straight leg raise. *Phys Ther*. 1983;63:1769-1773.
12. McGill SM. Electromyographic activity of the abdominal and low back musculature during the generation of isometric and dynamic axial trunk torque: implications for lumbar mechanics. *J Orthop Res*. 1991;9:91-103.
13. Parker R. The development of trunk stability in athletic movement. *NSCA Journal*. 1988;10:16-19.
14. Perry J, Bekey G. EMG-force relationships in skeletal muscle. *CRC Crit Rev Bioeng*. 1981;7:1-22.
15. Ricci B, Marchetti M, Figura F. Biomechanics of sit-up exercises. *Med Sci Sports Exerc*. 1981;13:54-59.
16. Schwarzenegger A. *Encyclopedia of Modern Bodybuilding*. New York, NY: Simon & Schuster, Inc; 1987:501-541.
17. Stokes IAF, Moffroid M, Rush S, Haugh LD. EMG to torque relationship in rectus abdominis muscle results with repeated testing. *Spine*. 1989;14:857-861.
18. Walters CE, Partridge MJ. Electromyographic study of the differential action of the abdominal muscles during exercise. *Am J Phys Med*. 1957;36:259-268.
19. Winer BJ. *Statistical Principles in Experimental Design*. 2nd ed. New York, NY: McGraw-Hill Book Co; 1971:514-601.
20. Yessis M. The midsection: your essential link. *Sport Fitness*. 1985;1:91-93.
21. Zetterberg C, Andersson GBJ, Schultz AB. The activity of individual trunk muscles during heavy physical loading. *Spine*. 1987;12:1035-1040.
22. Zuccolotto T. Abs like giant raviolis. *Flex*. 1989;7:45-48.

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## Making Yourself Mobile With a Medical Golf Cart

James W. Berry, BS, ATC, SCAT/EMT

**Abstract:** *The use of the specially designed and equipped golf cart in sports medicine has become commonplace at the professional and collegiate levels. However, at the high school level, athletic trainers often have been stymied by financial limitations that prevent them from purchasing professionally designed and manufactured medical golf carts. Through this article, I hope to share with high school athletic trainers my experiences in designing, obtaining, and equipping a medical golf cart that is affordable and suitable for use in the high school setting.*

High school athletic trainers often need to be in different places at the same time. This presents a unique and often troubling situation. Because most high schools employ only one athletic trainer, high school athletic trainers are not afforded the luxury of having an assistant or assistants to cover a myriad of sport practices and contests. Thus, they often must pick and choose what to cover and when. I have found that one possible solution to this dilemma is the specially equipped medical golf cart, which allows easy and quick movement from place to place.

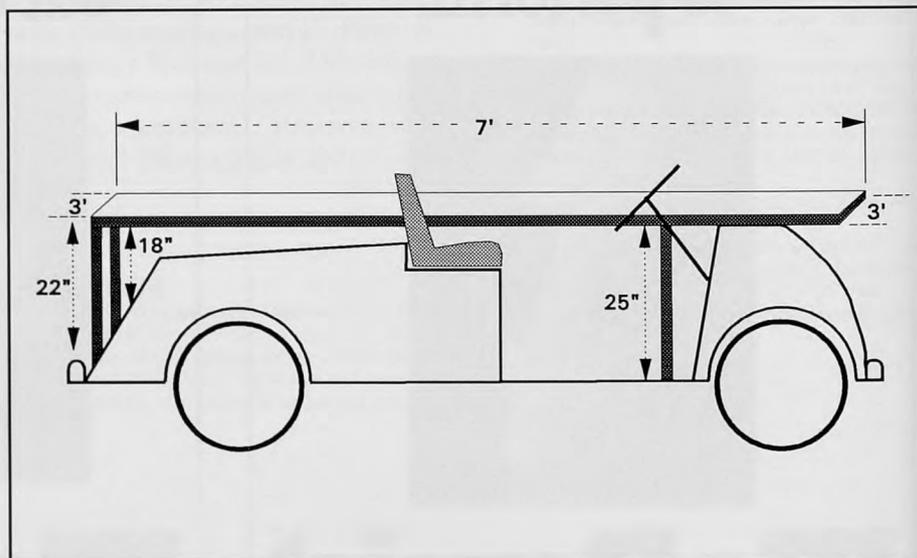
James W. Berry is the head athletic trainer at Myrtle Beach High School, Myrtle Beach, SC 29577.

There probably are few individuals in the athletic training profession who have not seen the medical golf carts (or "field vehicles") used at the professional level and even at some colleges. Models also have been displayed at NATA conventions. However, most of these models are designed and manufactured professionally, retailing for thousands of dollars. Unfortunately, most high school athletic trainers do not have thousands of dollars at their disposal, so it is usually prohibitive for high school athletic trainers to acquire these vehicles.

My high school is no different, but I have been able to design, manufacture, and equip my own medical golf cart through the cooperative efforts of the high school, sports booster club, local vocational center, and local businesses.

First, you must obtain the vehicle. It does not have to be brand new, but it should be in excellent mechanical condition with a good body and frame. It also should be a four-wheeled model (rather than three-wheeled) to provide stability because a stretcher bed will be attached to the passenger side of the vehicle. The most obvious place to look for a quality golf cart would be local golf courses. If they cannot or will not assist you with a donation or suitable purchase price, then ask them to put you in touch with the company they rent or purchase their carts from, and perhaps that company can help you.

After you have identified an individual or business that is willing to help, approach them with a detailed design and explanation for converting the golf cart for use in sports medicine.



**Fig 1.—Bed construction and placement on golf cart. (NOTE: Because the bed hangs over the right side of the golf cart approximately 6 inches, the 25-inch and 22-inch side support bars are angled to connect to the frame. The 18-inch support bar is anchored straight to the frame. The front left side of the bed is secured flush to the front of the vehicle.)**

The design plan should illustrate how the vehicle will look when completely converted and explain how it will be used in your program for covering athletic activities and transporting injured athletes. It also is recommended that you explain that the vehicle will be used only for sports medicine purposes. This will help to assure potential donors that their donation will be used for the purposes they intended.

Once the golf cart donation is secured, you most likely will want the vehicle to positively represent your sports medicine program and athletic department. I decided to have the vehicle painted in the school colors and have the same decals placed on the sides of the vehicle that are worn on our football helmets. In addition, I had "SEAHAWK SPORTS MEDICINE" printed across the front of the vehicle.

To make this project an educational experience for students as well, I recommend that you enlist the assistance of



**Fig 2.—The completely converted medical golf cart.**

the local vocational center's auto body shop, as I did. In my case, the instructor agreed to have his students repair minor damage to the fiberglass body of the vehicle and paint it to the specifications explained earlier. This allowed me to eliminate almost all expenses for repairing and painting the vehicle body and allowed the students an opportunity to practice their repair and painting skills.



**Fig 3.—The medical golf cart equipped with two-way radio/telephone (bottom left); splint kit (middle, under bed); portable oxygen unit (under bed, next to seat); and backboard and field kit (on bed).**

Upon completion of the body repairs and painting, the golf cart was ready to be fitted with the stretcher bed. Again, I called upon the vocational center and its welding instructor to assist me. He

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agreed to construct the bed and attach it to the vehicle according to the following specifications:

1. The bed top must measure 7'x3' to accommodate an injured athlete and/or medical equipment needed to care for an injured athlete (Fig 1).
2. The bed frame should be made of steel and be covered with 3/4-inch marine grade plywood and indoor/outdoor floor covering. In my case, the frame was constructed of 2-inch square steel hollow tubing.
3. It must be able to support 400 pounds.
4. The weight of the bed with or without an individual or equipment on it should not cause the vehicle to tip over when sitting idle or being driven.
5. The bed should be placed on the passenger side of the vehicle, running lengthwise and allowing ample room for the driver.
6. The frame and bed should be easy to remove to allow for mechanical upkeep of the vehicle.

Once these specifications are met and the vehicle is fully operational (Fig 2), it should be equipped with the equipment that the athletic trainer feels is necessary. Our vehicle is equipped with a backboard, splint kit, portable oxygen unit, and field kit. Because communication is also vital in our profession, I equipped the vehicle with a portable, two-way radio/cellular telephone, which was donated to my program through the cooperative efforts of our sports booster club and a local communications company (Fig 3).

With the cooperation and assistance of local businesses, your school, booster clubs, and vocational training centers, you can easily and economically obtain a similar vehicle. As a result of such cooperation, the total cost to my athletic department was \$350.00. This covered the cost of paint, steel for the stretcher bed frame, hardware, plywood, and indoor/outdoor floor covering.

The fully equipped medical golf cart will allow you the capability to better handle many medical situations that

might arise on your athletic campus. You will be able to move about your facility quickly and easily with any equipment you might need at your fingertips. The vehicle also will allow you to transport injured athletes safely and efficiently to the training room or a waiting ambulance.

While the medical golf cart at the high school level might not have a giant helmet attached to it or look as "snazzy" as those often seen on television, it is an invaluable tool to sports medicine professionals. I would recommend highly that ALL high school athletic trainers investigate the possibility of obtaining one.

### Acknowledgments

I would like to thank Lorin Cartwright, ATC/EMT, and Joe Kinney, ATC, for their assistance, support, and encouragement.

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**Abstract:** Helping disabled workers to return to work is the goal of many corporate rehabilitation efforts. Increasingly, employers are providing rehabilitation services either as part of their overall disability management approach, or as a special program aimed at facilitating return to work. Finding a program that offers cost management, as well as facilitating appropriate return to work is the objective of most employers in effective disability management. Disability management involves two types of costs: wage-related benefit costs and costs for rehabilitation services or treatment. Whether the injuries occur at work or leisure, the costs will be borne by the company in some fashion. There are clear benefits from using an in-house program. Increasingly, corporate managers are employing athletic trainers to provide this rehabilitation service on-site.

**A**round the country, companies of all sizes are realizing what collegiate sports and professional teams have known for a long time; in-house rehabilitation is cost-effective. This is revealed most dramatically by the number of rehabilitation/fitness centers springing up around corporate America. Recognizing that employee productivity is the determining factor dictating red or black ink on the company ledger, and that morale and goodwill greatly influence that productivity, modern industry has embarked upon a program designed to complement both. The prompt return to work of injured and/or sick employees is the goal, with the corporation and employees the beneficiaries.

Increasingly, athletic trainers are finding employment with midsize to large companies. However, the role that athletic trainers play is still puzzling, especially to corporate managers.

# Industrial Medicine and Athletic Training: Cost-Effectiveness in the Non-traditional Setting

Gregory R. Zimmerman, MSA, ATC

## Industrial Health Care Costs

Industrial medicine traditionally has concentrated on prevention of acute and chronic disease and injury. Research indicates, however, that a comprehensive team approach for rehabilitation of an injured or disabled worker is necessary.<sup>2,5,7,11,13,15,19</sup> This enables him/her to remain a productive member of the work force and society.

Failure to attend to the needs of disabled workers creates a cost to society in at least three ways:

1. severe financial implications for industry in terms of labor turnover and the recruitment and training of new workers;
2. secondary effects on the workforce participation of persons who must care for a disabled person; and
3. diminutive number of workers in the active workforce whose financial contributions sustain systems of social insurance and benefits.<sup>4</sup>

Business and industry have come to realize that healthy employees can help reduce costs. Many industrial firms have reevaluated the practice of simply "pensioning off" chronically injured or disabled employees. Experienced employees represent an investment, an appreciating asset, and a resource to their firms. Goldfarb<sup>5</sup> suggests that America's competitiveness in the world market depends, to an extent, on industry's ability to keep workers healthy, fit, and on the job.

Not only does the employer have an investment in the employee in training costs, experience, and goodwill, but a healthy employee is more productive,

has fewer accidents, takes fewer sick days, and uses fewer health insurance benefits. After assuming the presidency of Chrysler Corporation, Lee Iacocca discovered that Blue Cross/Blue Shield was the company's biggest supplier. Chrysler was spending more money on health care than for steel and rubber.<sup>9</sup>

Cost containment of workers' compensation medical expenses has become the focus of heightened levels of interest. Standard industry practice has been to send an injured employee either back to work, home, or to an outside doctor or hospital for treatment and rehabilitation. The extent of treatment and rehabilitation has never really been controlled effectively by the company.<sup>7</sup>

The Wyatt Company reported in 1989 that 80% of hospital bills are incorrect.<sup>2</sup> One third of the bills reviewed in the study were too low, and two thirds of the bills were too high. It is estimated that hospital bill reviews result in as much as 15% savings in overall costs. According to Lynn Jones, manager of worksite health services in the American Hospital Association's Division of Ambulatory Care and Health Promotion, "From the employer's perspective, the goal is to get the employee back on the job. For the employee, the goal is to prevent the injury from recurring; for the hospital, it is to make a profit."<sup>3</sup>

## Industrial Rehabilitation Programs

The aim of early rehabilitation is to prevent an employee's passing from

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productive activity to social security rolls by maintaining his or her working capacity and adjusting work to his or her capabilities. If proven successful, this activity might prevent the disability process and thus limit the growth of the cost of social and medical services. Increasingly, employers are providing rehabilitation services either as part of their overall disability management approach, or as a special program aimed at facilitating return to work.<sup>13</sup>

Some employers, resenting the high cost of workers' compensation, tend to feel the injury payment system is abused by workers who see even the most minor ache as a ticket to getting money for nothing. Indeed, such abuses might exist. Factory workers tell of rehabilitation programs in their plants where workers' compensation recipients are brought in to perform simple tasks while collecting full pay. Some participants, they report, come in on crutches, but drop the act when the work day is done.<sup>11</sup>

There always will be those who take advantage of a situation, but coordinators of rehabilitation programs supervised by athletic trainers remark that most injured workers just want to get better.<sup>19</sup> They maintain, and employers are beginning to agree, that getting injured workers into programs immediately and working with them to prevent further injuries are steps that help ease the pain of workers' compensation bills.

Physical rehabilitation programs, expanding in part because the US Department of Labor requires employers to make some kind of rehabilitation effort for injured employees, use a variety of techniques to achieve their goals. The distinction between industry-based rehabilitation programs and disability management programs is a bit artificial. Certainly, there are many common objectives, policies, and service elements. Disability management is essentially a secondary and tertiary prevention strategy closely allied to occupational health care, while industry-based rehabilitation programs more commonly reflect restorative rehabilitation practices, usually following a substantial

injury.<sup>4,11</sup>

The benefits of early return from injury and/or sickness for both the employees and the companies are readily apparent. Proper and prompt rehabilitation, in terms of alleviating pain and stress, is invaluable. Monetarily, companies have realized savings of hundreds of thousands of dollars, and employees gain by returning sooner to full paychecks.

Industry-based rehabilitation efforts might include a comprehensive array of medical treatment, retraining, counseling, work adjustment, sheltered work, and job accommodations. Employer-based, "in-house" rehabilitation schemes have been demonstrated in Australia, Sweden, and the United States.<sup>4</sup> These programs all make an effort to avoid the injured employee's withdrawal from the labor market through a conscious and proactive policy of in-house physical rehabilitation/fitness.

Perhaps the most common remark made by employees who have used their respective employers' rehabilitation/fitness facilities is one of gratitude towards their company.<sup>19</sup> Workers who have suffered the trauma of injury recognize not only the physical benefits of these programs, but also the psychological effects. Active participation in their own wellness, not merely waiting for nature to take its own time and course, is a positive and beneficial ingredient in the healing process and one that is nurtured by these rehabilitation/fitness programs.

Companies with these programs are somewhat unique in their approach to the fitness movement that has swept the country. There is a presumption that these programs have proven their value in increasing productivity and reducing the spiraling costs of health care. They might also give a company the competitive edge in obtaining and keeping good workers. Many corporate rehabilitation/fitness programs are viewed as an "elitist" perk, reserved for top managers and executives only. However, on any given day in these rehabilitation/fitness centers, one can witness high-level brass working side-by-side with the

unionized blue-collar workers.

## Industrial Injury Surveys

Companies started offering health programs after surveys nationwide and throughout the automobile industry revealed that 80% of workers do not get enough exercise, 42% smoke, and at least 50% have high cholesterol levels.<sup>12</sup> The number of on-the-job injuries and illnesses in America surged in 1991 to 6.8 million, the highest level on record. This marked an increase of approximately 200,000 from the previous year, according to a study by the Bureau of Labor Statistics. It was the highest number of work-related injuries and illnesses since the US Department of Labor began tracking such figures in 1972. Of all the reported cases of injury and illness in 1990, nearly half were serious enough to require workers to lose time on the job or have their work activity restricted.<sup>1</sup>

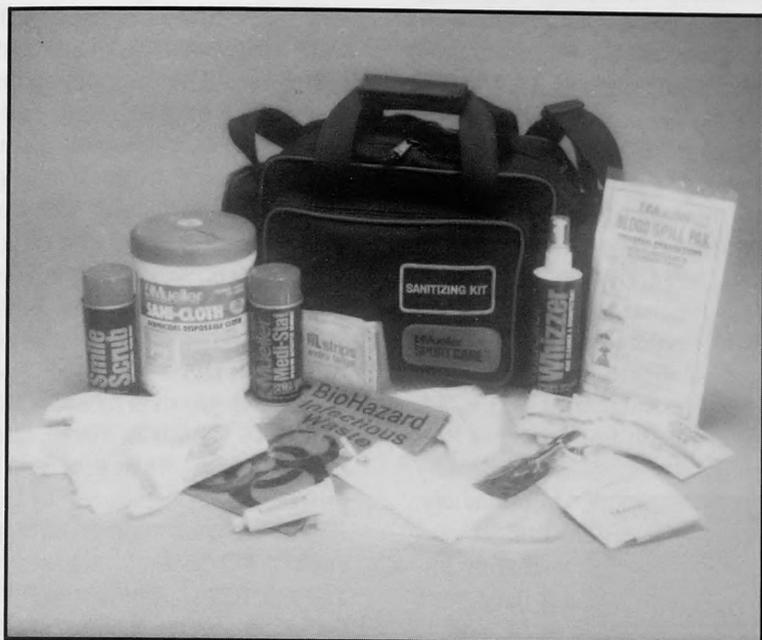
Eight industries reported at least 100,000 injury cases each in 1991.<sup>16</sup> Those reporting were eating and drinking places, hospitals, retail grocery stores, trucking and over-the-road couriers, nursing and personal care facilities, department stores, motor vehicle manufacturing, and hotels and motels.<sup>18</sup>

Although manufacturing injuries had decreased slightly, factory injuries and illnesses accounted for approximately one third of the total reported injuries. The service industry accounted for 20%. As in other recent years, disorders associated with repeated trauma, for example, carpal tunnel syndrome, continued to increase. These disorders, which now make up nearly 60% of all illnesses, often are suffered by typists or assembly line workers who repeat the same action throughout the day.<sup>1</sup>

## Program Models

The rehabilitation/fitness facility at Saginaw Division-General Motors Corporation is within the boundaries of the 1 square-mile manufacturing complex of approximately 10,000 employees. GM's 13-year-old, in-house rehabilita-

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tion program was implemented after a local orthopedic surgeon, Dr. Ben Mayne, challenged upper GM management to enlist the services of athletic trainers in rehabilitating injured and postoperative employees. The initial capital outlay for equipment and facilities, in addition to the benefits and salaries of the athletic trainers, were recovered within 6 months of operation through cost savings.

Currently, the rehabilitation/fitness center at Saginaw Division GM employs two certified athletic trainers, is open Monday through Friday from 6 AM to 8 PM and averages 312 patients annually. In 1991, we administered 9162 treatments during 3791 patient visits. Strains, sprains, contusions, dislocations, fractures, and inflammatory disorders make up 81% of the caseload. More than 280 employees regularly use the center for some form of fitness/maintenance following recovery from injuries. Over a 3-year period, beginning in 1988, Saginaw Division has saved \$3,531,335 by conducting rehabilitation in-house versus out-source care rehabilitation.<sup>19</sup> Like many of the in-house models, Saginaw Division GM also rehabilitates nonoccupational injuries suffered by their employees. There are no charges or billing for services rendered. This is seen as a benefit for both the company and the employees and helps to improve relations between management and labor.

At Walbro Corporation in Cass City and Caro, Michigan, officials have recorded a 54% decrease in workers' compensation claims since the company initiated fitness programs in 1985. Walbro, which employs more than 300 people, builds small engine carburetors and fuel pumps. Nearly all injured Walbro workers make use of the 21 pieces of Nautilus and aerobic exercise equipment that are located at the facility for rehabilitation. In 1985, Walbro management calculated that dollars saved from reduced insurance claims would cover the facility cost within 4 years. They were surprised and pleased when the books balanced within 10 months. During the first quarter, there was a 36% reduction in absenteeism, and the company realized a savings of

7.6 cents an hour per employee on all medical costs, including workers' compensation. In addition, Walbro has realized a 79% reduction in occupational time off because of injury and illness.<sup>14</sup>

In-house rehabilitation/fitness programs are represented not only in the manufacturing industry, but also in such diverse settings as the educational arena. The Central Health Improvement Program at Central Michigan University (CMU) invested \$450,000 into a healthletics program designed to reduce work-related injuries and, in turn, decrease the amount of money the university was spending for workers' compensation payments. Central Michigan University employs 2364 people. For the first 6 months of operation, CMU savings because of their employees' ability to return to work sooner were estimated at \$213,244. The Central Health Improvement Program facility also saved approximately 2423 days of lost time.<sup>10</sup> Unfortunately, recent state educational budget cuts have placed the Central Health Improvement Program facility in a precarious position. Too often, athletic trainers face an uncertain future because these types of programs are the first to be sacrificed during depressed economic times.

One industry realizing a high incidence of overuse and repetitive motion disorders is the meatpacking industry. Wilson Brands Corporation, with 1200 employees, has reduced dramatically two significant cost-related areas through its rehabilitation program. Comparing a 6-month period in 1988 with the same period in 1990, days lost were cut in half, and workers' compensation cases requiring surgical care were reduced by 95%.<sup>8</sup>

While these programs' figures are impressive, without direct correlation, one must consider that other extraneous factors also might have had an impact. Financial incentives, benefits restructuring, improved medical technology, and creative bookkeeping are some possible influences.

### **Corporate/Industrial Survey**

In the Fall of 1991, I conducted an informal survey of 10 corporate/in-

dustrial sites that employ certified athletic trainers. The sites included the following variety of company settings: meatpacking and beverage, service industry, builder's hardware, chemical production, petroleum, automobile manufacturing, university, rubber, and small engine components.

Six of the corporate/industrial athletic trainers worked a 40-hour week, with nonworking weekends and holidays. The remaining four occasionally worked upwards of 60 hours per week. Half of the sites did not have assistant staff. In those that did, the average annual starting salary of assistant staff members was \$22,000 to \$24,000. The supervisory ATCs had an average annual salary of \$40,000 to \$42,000. The ATCs in industry spent, on an average, 54% of their work day conducting physical rehabilitation. The remaining time was shared among administrative, wellness, and safety programs.

The ratio of number of patients to each ATC in the industrial setting average 10:1. Approximately 60% of the injuries were sustained at work (occupational), and nonoccupational injuries accounted for the remaining 40%. Six of the surveyed sites routinely have annual caseloads of more than 250 patients.

Nine of the 10 corporate industrial sites surveyed reported that they did not bill for services. These employed only certified athletic trainers. The one site that did bill for services was coordinated by a physical therapist.

Results of the survey indicated that the title of certified athletic trainer was an inaccurate description of the profession, based on the type of work performed at the corporate/industrial sites. In addition, the majority of the athletic trainers working within this unique setting felt that the NATA was not adequately addressing the needs of corporate/industrial athletic trainers.

### **Conclusions/ Recommendations**

Certified athletic trainers are beginning to have a substantial impact in an area outside of the standard athletic arena. Extraneous costs associated with

the treatment and rehabilitation of injuries sustained by employees of corporate/industrial America have been reduced substantially with the employment of an athletic trainer. There currently are 15 to 20 industrial athletic trainers in the United States market.<sup>17</sup> The primary objective of these trainers is the prompt treatment and rehabilitation of injuries sustained by the company's most valuable assets, its employees.

Whether the injuries occur at work or leisure, the company bears the cost in some fashion. For many companies, it is an assumed debit or liability. The majority of corporate managers and administrators are unaware of the options available in reducing these costs.

An in-house model in a corporate setting is clearly beneficial. Advantages include: 1) firsthand knowledge of the company's culture, objectives, and workforce characteristics; 2) a tendency by internal employees to be more diligent in efficiently and economically using the services provided; and 3) the greater potential to ensure coordination, continuity, and availability of services.

The opportunities available for the certified athletic trainer in this setting are relatively unlimited. However, industry currently is not searching out and attracting athletic trainers. Until top level executives of industry learn of the advantages of in-house rehabilitation, it will be necessary for the National Athletic Trainers' Association to become proactive. An extensive plan needs to be designed to include curriculum development and continuing education of specialized athletic trainers. Also, a marketing strategy targeted at the managers of midsize to large corporations and industrial firms needs to be implemented.

For the student or athletic trainer contemplating a career in the corporate/industrial setting, a working knowledge of specific subject matter is recommended. This coursework would include ergonomics, occupational health and safety, labor relations, workers' compensation, environmental disease and industrial hygiene, worksite wellness, work simulation/hardening, functional capacity testing, cost jus-

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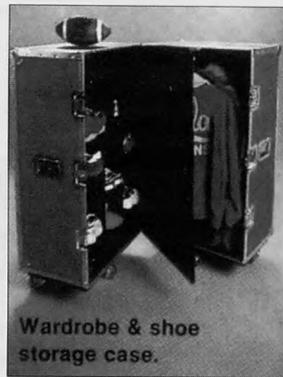
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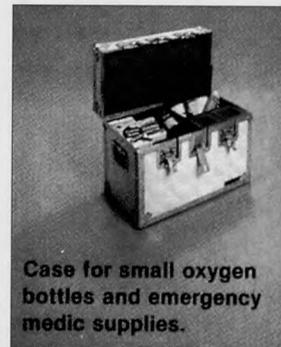
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Sports medicine is the study of the physiological, biomechanical, psychosocial, and pathological phenomena associated with exercise and athletics. It includes the clinical application of the knowledge gained from this study to the improvement and maintenance of functional capacities for physical labor, exercise, and athletics. It also encompasses the prevention and treatment of disease and injuries related to exercise and athletics.<sup>6,16</sup>

The field of sports medicine is established and respected. However, ignorance exists in the general public regarding the practice of sports medicine and athletic training, and the continued expansion of athletic trainers working in industry on nonathletic injuries. Traditional terminology that is presented in both NATA public relations efforts and printed materials needs to be modified and expanded to include this growing segment of our profession.\*

We must not close our minds to potential employment opportunities. Currently, there is dialogue concerning name change and state licensure. Many state licensure efforts have limited severely the practice and scope of athletic trainers to athletes and athletic injury. Much of the talk regarding name change centers around titles which are already self-limiting. As discussion continues and progresses to the point of action, the corporate/industrial athletic trainer needs to be considered. A title encompassing all specialties of our profession is a necessity and should not exclude future employment oppor-

tunities.

Industrial medicine is not new, but the concept of athletic trainers in industry is just beginning to grow. The single greatest threat to potential jobs for athletic trainers in the industrial and corporate setting continues to be restrictive state legislation. Employment, in this so-called nontraditional arena, depends on the foresight of our leaders and general membership. They must become proactive on state- and national-level policy and defeat protectionism.

### References

1. Ball K. On-the-job injuries at an all time high. *Detroit News*. November 20, 1991; 3E.
2. Bennett C. Containing workers' compensation costs. *Business Insurance*. 1990;24:21
3. Droste T. Rehabilitating injured workers is profitable. *Hospitals*. 1989;63:48.
4. Galvin D. Health promotion, disability management, and rehabilitation in the workplace. *Rehabil Literature*. 1986;47:218-223.
5. Goldfarb H. An insider's guide to choosing rehabilitation. *Risk Manage*. 1989;36:46-50.
6. Lamb D. Sports medicine-what is it? (ACSM President's Report). *Sports Med Bull*. 1981;16:1.
7. Major M. The industrial athlete. *Saf Health*. 1990;4:64-67.
8. Moore S. Therapracitics incorporated annual summary. Wilson Brands Corporation. *Workright*. 1991;1:1.
9. Moretz S. Chrysler takes a new look at in-plant medical care. *Occup Health*. 1989;51:39-41.
10. Murray C. Health facility surpasses its expectations. *Cent Mich Life*. 1988;2:3,14.
11. Price C. Painstaking therapy; advances in sports medicine have broad implications in treating injured workers. *Mich Business*. 1988;3:34-36.
12. Rudolf G. Company lifts the weight of workers' fitness costs. *Saginaw News* November 20, 1991; 3E.
13. Tate D. Building a better rehabilitation program. *Business Health*. 1987;4:32-35.
14. Thomas M. Treating the industrial athlete. *Lab Register*. 1986;7:100-101.
15. Tonti D, Trudeau T, Daniel M. Linking fitness activities to rehabilitation. *Business Health*. 1987;9:31-32.
16. Weidner T. Athletic training: time for a name change? *Athletic Training, JNATA*. 1991;26:252-254.
17. Wickman E. Industry poses new challenge for trainers. *First Aider*. January-March 1989;58:4.
18. Yarnall S. The 10 most dangerous places to work. *For Better Living*. February 1992;12:6.
19. Zimmerman G. *Cost Effective Disability Management: In-house Versus Out-source Physical Rehabilitation*. Mount Pleasant, Mich: Central Michigan University;1991. Thesis.

\*Editor's note: The NATA has begun using "physically active" to describe those who receive our services.

**Abstract:** Alcohol and other drug (AOD) abuse affects every sector of society, and student-athletes are no exception. Because many factors affecting athletes do not affect other students, athletic departments commonly approach prevention through AOD education. Different educational approaches are described in this article, particularly the Athletic Prevention Programming and Leadership Education (APPLE) model. Project APPLE is designed to enable an athletic department to systematically analyze its AOD prevention in seven areas: recruitment practices, expectations and attitudes, education and AOD programs, policies, drug testing, discipline, and referral and counseling. Because athletic trainers often are involved in this process, this article should help them to design more effective AOD programs.

**A**thletes must address the pervasive issue of alcohol and other drugs (AOD). Although this problem permeates every sector of society, it is news when an athlete is involved in an AOD incident. The negative publicity damages not only the athlete, but the integrity of the sport.<sup>5</sup> Martin and Thrasher<sup>7</sup> suggest that education is the best defense and should be at the top of the pyramid of prevention, with treatment and sanctions following. The athletic trainer, usually the one responsible for implementing AOD programs, should find the most effective prevention program.

In this paper, we discuss the need for thorough and effective drug education.

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# The Athletic Prevention Programming and Leadership Education (APPLE) Model: Developing Substance Abuse Prevention Programs

Susan J. Grossman, MSW, LCSW  
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Wei Li Fang, PhD

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We then describe the APPLE (Athletic Prevention Programming and Leadership Education) model, created and piloted at the University of Virginia, as one possible approach. This model has been funded by two National Collegiate Athletic Association (NCAA) grants for presentation to member institutions (January 1992 and January 1993).

## Drugs in Athletics

The literature suggests many reasons why athletes turn to drugs and alcohol. Student-athletes might feel more pressure to perform than the general student population, both inside and outside the classroom. They might strive to excel, not only athletically, but academically and socially as well. Pinkerton and associates<sup>9</sup> note other pressures that athletes encounter, eg, isolated living conditions in athletic dormitories and long hours spent practicing, training, and traveling. These demands can overwhelm some athletes, who might turn to AOD use in an attempt to cope.<sup>9</sup> These athletes might contend that drugs help them to compete by increasing

energy, strength, and endurance; or they might claim that the drugs help them to relax following competition.<sup>7</sup>

Martin and Thrasher<sup>7</sup> identified four behavioral tendencies which might incline an athlete to substance abuse. First, the athlete might be unsure of identity and self-image issues. Because athletes are in the public eye, many are subjected to unforgiving scrutiny and are expected to be role models. On one hand, they could be glorified in the press for athletic excellence and then, on the other hand, ridiculed for some infraction that, to them, is trivial.

Second, the athlete might suffer from an intense fear of failure, complicating the many pressures mentioned earlier. Intercollegiate athletics is no longer just a game. College sports have become big business, and a highly visible college athlete is subject to pressure to win and perform at maximum capacity.

Third, the athlete could suffer from a fear of aggression. While aggression is an inherent aspect of sports, it might be confused with violence directed at opposing players and teams. The negative

connotation might distress the athlete. A defensive back is expected to be aggressive, but an athlete could be better suited temperamentally to play wide receiver. Therein might lie a conflict.

Finally, peer pressure can influence an athlete's behavior. Like their peers, many college athletes have an intense desire to be accepted. In order to join a particular clique, athletes might use drugs, even if this behavior compromises their internal values. Athletes can jeopardize their eligibility if AOD use affects academic performance through absenteeism, inattention, poor motivation, and lack of preparation for classwork and exams.

### Successful AOD Education Programs

Athletes represent many facets of society, bringing varied customs, values, and traditions to their sports. Naturally, they tend to exhibit the same tensions, anxieties, and problems as the rest of society.<sup>7</sup> It is, therefore, important to educate student-athletes to identify and control the pressures they encounter. But, what characterizes an effective education and prevention program? While numerous programs have surfaced in recent years, there are few that meet the specific needs of the college athlete. Several universities now have made AOD information a mandatory part of freshmen orientation. Often held at the beginning of the school year, these programs usually provide basic AOD education and general information regarding institutional policies.<sup>10</sup> This general information might benefit some students; however, for athletes, the effects are dubious at best as a result of rigorous, time-consuming training schedules.

Many universities require their athletes to listen to major speakers brought in during the year. Attendance is usually mandatory, but results do not seem to be meaningful because the speakers and topics are not necessarily relevant to the athletes.

The NCAA suggests drug testing as a deterrent to drug use, and many member institutions have developed more stringent policies for screening and sanction enforcement. All athletes who

have tested positive need effective treatment programs prior to returning to their teams. Unfortunately, the positive test results of important team members are sometimes ignored, and sanctions are not always enforced.

At the college level, many AOD abuse prevention/education programs target students in need of treatment. Other programs provide general educational information in the hope that knowledge will somehow deter the college student from abusive patterns. We felt that any programs aimed at athletes must specifically address their concerns, including the physical demands of particular sports, the misguided assumption of immortality so prevalent in this age group, protection of athletes' privacy and confidentiality, peer pressure and problems related to frequent travel.<sup>7,10</sup> In addition, the athletes needed to have a sense of ownership in the program to ensure their cooperation.<sup>6</sup>

Grossman<sup>6</sup> found that many drug education programs use the "shotgun" approach. A great deal of information is tossed out to the student population at large in the hope that it will "hit" someone. No specific audience is targeted by these broad brush programs and/or educational campaigns, and there is little evidence to show that they affect students' attitudes or usage.<sup>2,4,6</sup>

Historically, prevention models have been divided somewhat arbitrarily into three components: primary, secondary, and tertiary. In order for alcohol and other drug education to be comprehensive, it must incorporate all of these components, from basic information and education through referral and treatment resources.

Primary prevention emphasizes the health hazards and potential dangers of substance abuse to people and populations.<sup>7</sup> Most primary prevention programs target those who have not had problems. These programs urge abstinence within the framework of basic AOD information. However, providing knowledge alone is not sufficient; an effective prevention model must aim at attitudes and behaviors.<sup>2,4</sup>

Secondary prevention focuses on early identification and referral to appropriate resources. Emphasis is on ex-

amining the source of the problem and developing strategies to curtail sustained, long-term use and/or abuse.<sup>7</sup>

Tertiary prevention includes treatment in both inpatient and outpatient settings. It is directed to those with more serious, long-term problems and might include hospitalization and detoxification.<sup>7</sup>

Pinkerton and colleagues<sup>9</sup> suggest a focused, three-component model.<sup>7</sup> The first component, the short-term approach, includes preventive measures that might involve one or more of the following: environmental and time management, coping skills, relaxation training, and thought stoppage. Cognitive behavioral therapy is the second component, focusing on mental imagery and practice to overcome the potential side effects of anxiety, depression, and anger that might lead to substance abuse.<sup>9</sup> The third aspect of this model centers around career/vocational counseling. Many college athletes, intoxicated by the glamour and spotlight of sports, have neglected the skills necessary to develop a life after athletics.<sup>9,10</sup> The anxiety of entering the real world is alleviated to some degree if the athlete succeeds academically and chooses an appropriate career.

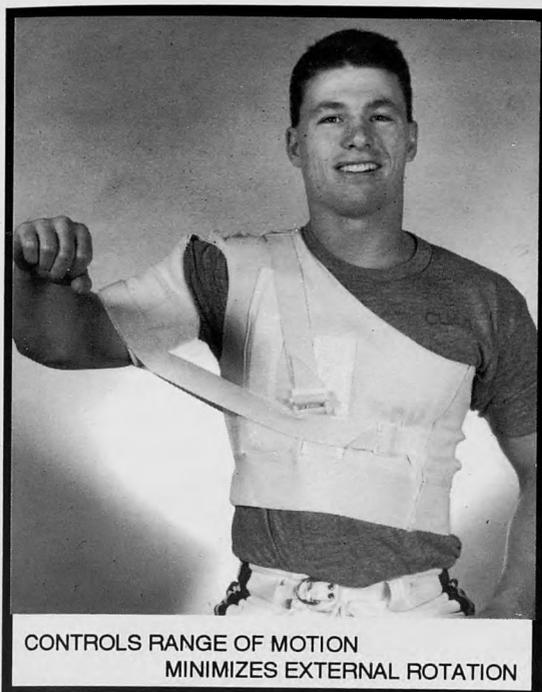
### Various Education/Treatment Approaches

Because substance abuse is considered one of society's most serious problems, education and prevention programs are becoming more common. Businesses, organizations and institutions recognize that programs must emphasize education, prevention, and rehabilitation, rather than punishment.<sup>5</sup> AOD education must encompass the reasons for use and abuse, behavioral characteristics of users, physiological effects, and psychological issues.<sup>3</sup>

The etiology of substance abuse in athletics can be associated with the physical, psychological, and social demands created by the sport.<sup>7,9</sup> It is, therefore, important to fully comprehend each demand and devise worthwhile programs that will meet the needs of the athletes involved.<sup>7</sup> Inconsistencies in substance abuse education might hinder the success of these

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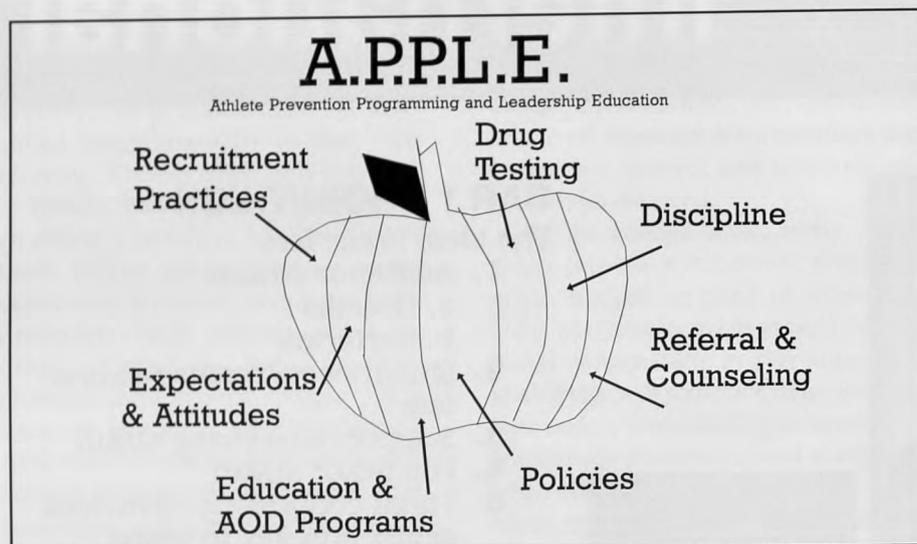
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**APPLE Model for AOD Evaluation.**

programs, perhaps as a result of obscure goals and objectives. Athletes, accustomed to structure and discipline, might find it difficult to operate successfully within a prevention/education model that is not clear.<sup>6,10</sup>

There is no ideal substance abuse education program. The particular educational goals for the athlete must be derived through thorough and specific appraisal.<sup>10</sup> The nature of the sport, policies and procedures regulating substance abuse at the individual institutions, drug testing policies, and the availability of psychological and substance abuse treatment resources are all factors that must be considered in addressing the needs of the athlete.<sup>10</sup>

All too often those involved in sports are connected with allegations of date rape, paternity suits, driving under the influence, drunk and disorderly conduct, and academic failure. Issues related to these concerns should be addressed as part of the education/prevention program.<sup>16</sup> Furthermore, different teams have specialized interests which should be addressed. For instance, football players might need to address date rape; the lacrosse team might need to concentrate on binge drinking; and cross country runners might have a greater interest in eating disorders.

### Various Treatment Programs

Professional sports, in contrast to college athletics, have institutionalized

league-wide policies and procedures that govern the education and rehabilitation of AOD users.<sup>7,10</sup> The following are the general components of three education/prevention programs that are being used actively.

The education program used by the National Basketball Association (NBA) mandates that all players within the league must attend two seminars over the course of one year and that rookies must attend an additional session during the preseason.<sup>7,10</sup> This additional seminar introduces the athlete to available resources and points out potential problems in professional athletics that could lead to substance abuse. This NBA agreement has a written statement endorsed by the players. Unfortunately, this program fails to address the ethnic, social, and psychological adversities that the athlete faces, and family involvement is minimal during rehabilitation.

The program of the National Football League focused initially on the athlete as an individual, but recently has been expanded to include pressures associated with sport involvement.<sup>7</sup> The primary prevention strategy includes drug education for players, as well as coaches.<sup>7,10</sup> The educational seminars deal with attitudes and ideas surrounding AOD use.<sup>7</sup>

The Cleveland Clinic Program includes primary, secondary, and tertiary prevention and educational elements.<sup>7</sup> The program is team-oriented and func-

tions on the "links in the chain" theory. The links represent all facets of the organization from owners to management to coaches to players. Group therapy, known as the "Inner Circle," is used, specializing in self-help and spiritual directives and including a family program.

### Background of AOD Programs in The Department of Athletics at The University of Virginia

The athletic department at the University of Virginia has had a drug education and testing program in effect since 1985. Prior to 1989, all student-athletes attended a mandatory meeting and educational session. Athletes were required to sign testing consent forms before checking out equipment for athletic participation. The department also provided speakers on AOD use and abuse, but this education component of name speakers and law enforcement personnel was mostly an ineffective, superficial prevention program; the athletes were inattentive and expressed displeasure at having to attend presentations they felt were a waste of time. General topics for the mass meetings often did not address concerns of the individual teams. Despite mandatory preseason testing and random drug testing throughout the year, despite referral for positive tests, we had no prevention and educational program designed specifically for each sport. As a result, the athletes were indifferent.

Because the AOD education did not seem to meet the needs of the athletes, the department turned to the University's Institute for Substance Abuse Studies (ISAS) for assistance in devising a more effective program. This request resulted in the Student Athlete Mentor (SAM) Program.

### The SAM Program

Peer education has been shown to be an effective means of presenting prevention material<sup>8</sup>; therefore, each athletic team was asked to express its specific need regarding AOD information, thus becoming actively involved in programs tailored to those needs. Each team elects individuals who are

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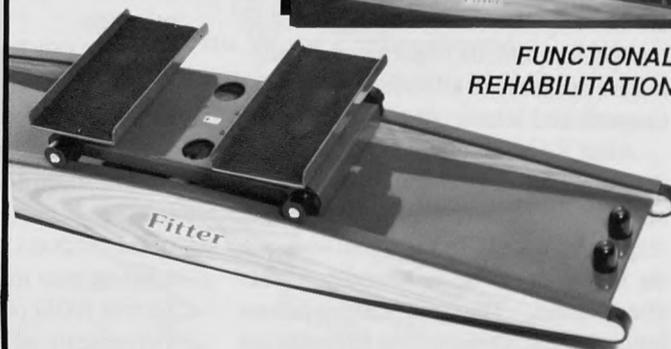


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SAMs are not watchdogs over their friends; rather, they are students whose peers admire them. They provide useful information, but they are not expected to report their friends to any authority or to reprimand teammates in any way. As internal resources for their organization, SAMs arrange education and prevention workshops and are available to listen to problems. They are aware of referral resources and can help teammates look at alternative solutions to problems that might arise.

The elected SAMs attend two training sessions that deal with a variety of issues student-athletes face on a daily basis. The first training session includes alcohol awareness activities, an overview of problems commonly experienced by college students in relation to alcohol abuse, and discussions about issues specific to their own team. Most of the session is conducted in small group discussions, and the policy of confidentiality and anonymity is stressed throughout the training. The second training session emphasizes the skills, information, and referral sources that SAMs might need to use.

Ironically, most of the SAMs requested further training sessions to address areas not discussed in the initial sessions and to expand on previously presented information. The success of the training sessions could be related to the fact that athletic department personnel are not present, allowing the athletes to speak and interact more freely.

After SAMs complete their training, they are asked to design and provide a substance abuse seminar for their respective teams. Educational sessions do not have to be confined to AOD abuse issues. They can address issues involving eating disorders, date rape, or any issue relevant to the individual teams. The SAMs remain in close contact with an ISAS staff member for ongoing support and additional information as needed.

### **The Athletic Prevention Programming and Leadership Education (APPLE) Model**

Because the athletic department plays such a vital role in the lives of

athletes, its hierarchies, policies, and procedures must be considered. Although the athletic department, as part of the broader university, is subject to university-wide rules and regulations, the department often serves as the major focus for the student-athlete. The athlete's primary perceptions regarding AOD use stem from the way this department enforces, or conversely ignores, policies and regulations.

Student-athletes often feel that the athletic department has its own policies and procedures and is not governed strictly by the entire university policy, a belief that is reinforced by coaches, athletic trainers, and other athletic department staff. It is essential that the athletic department's structure, both formal and informal, be examined and that policies and guidelines be rewritten if necessary in order to provide comprehensive, meaningful AOD prevention for the student-athlete.

With this in mind, the APPLE model was created for the University of Virginia's athletic department. This comprehensive model, designed specifically for athletes, includes both primary and secondary prevention. The goal is to enable an athletic department to analyze its position on AOD use along a continuum from enabling messages, those that implicitly or explicitly sanction AOD use, to proactive prevention, an emphatic, consistent "no-use" message.

The APPLE model consists of seven segments or "slices": recruitment practices, expectations and attitudes, education and AOD programs, policies, drug testing, discipline, referral and counseling (See Figure). Policies form the core of the program. While they must dictate a strong peer leadership component, effective AOD policies require active involvement of administrators, staff, coaches, student athletic trainers, cheerleaders, and managers, anyone who is involved directly with the athletic department.

In response to issues raised through the SAM program, the University of Virginia athletic department applied the APPLE model during the fall of 1990. All areas of the athletic department were included as integral elements. However, the success of the program

resulted from a strong peer education model which provides the bulk of prevention and education programming.

In order for athletic departments to develop effective policies and programs for prevention, education, and referral, they must examine carefully each slice of the APPLE model, making use of available local resources.

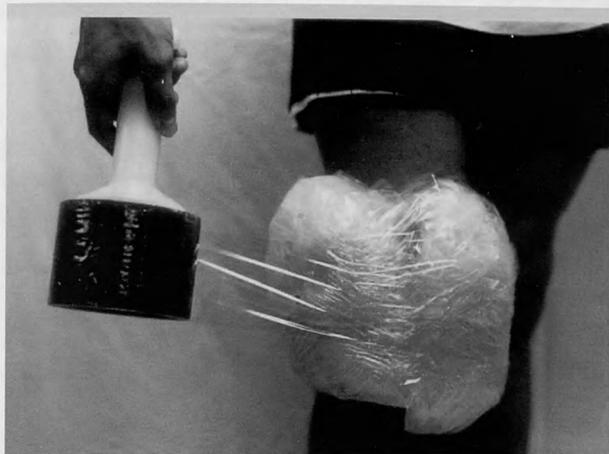
**Recruitment Practices.** The athletic department must examine all information that is relayed to a potential student-athlete regarding AOD use at the school and within the department. Prior to a recruit's visit, the department will schedule activities, examining them for implicit and explicit messages regarding AOD use. The athletic department must not promote or condone illegal AOD activities of any sort. All AOD messages, verbal and written, formal and informal, must be consistent with school and department policies. The athletic department should recognize that the behavior of the recruit usually will reflect the behavior of the host, who bears the legal responsibility for the recruit.

For example, getting a recruit intoxicated: Is this considered entertaining the recruit? Is it expected by the coaches? Obviously, this is a legal dilemma, as it is unlawful for individuals under the age of 21 to purchase and/or consume alcoholic beverages. Ramifications could include loss of eligibility, criminal charges, or even loss of life in an accident.

**Expectations and Attitudes.** Expectations and attitudes of the athletic department as they relate to both the academic and athletic performance of the student-athletes need to be examined as well. Here, the athletes' roles within the university community should be defined, and athletes should be reminded that they are students first and must excel in the classroom. A mandatory session explaining this philosophy should reach first-year and transfer students. All too often, administrators, coaches, and athletic trainers unconsciously convey enabling messages regarding AOD use. It is crucial that these individuals unequivocally communicate proactive prevention, leaving no room for interpretation.

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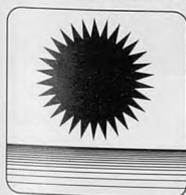
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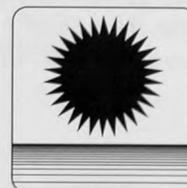
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Coaches, staff, student-athletes, and others affiliated with athletics must maintain a consistent no-use message, supported by their own actions and reinforced during orientation and throughout the year. Personnel in the athletic department must adhere to the same standards expected of student-athletes.

**Education and Programs.** By far the most important aspect of the APPLE model, the education and programs slice must clarify misconceptions that might perpetuate abuse. Ideally, all incoming athletes should participate in a mandatory education program conveying no-use messages for everyone under 21 years of age.<sup>3</sup> All students should be informed about federal, state, and local laws and regulations, including those of the university. Informational materials and programs must be made regularly available, through identified resources, and must be tailored specifically to topics pertinent to the student-athletes. Student mentors or peer counselors must be trained and supervised in dissemination of AOD information and communication skills. Coaches and staff should be well-informed about AOD facts, especially as they relate to student-athletes.

**Policies.** The athletic department's AOD policies must adhere to university rules and regulations. In addition, they must incorporate relevant federal guidelines. Clearly defined drug testing standards, procedures, and sanctions should be sent to students and their parents and/or guardian at the time of the student's acceptance. The policies should be well disseminated, uniformly enforced, and regularly reviewed; they should be clear, accurate, and uncompromising.

**Drug Testing.** The steps for collection and administration of drug testing must conform with the NCAA guidelines. Privacy and confidentiality of testing procedures can be ensured by upholding the chain of custody, which places the responsibilities of testing on many groups and persons, not on a single individual. The chain at the University of Virginia involves

coaches, university police officers, the head athletic trainer, the athletic director, a private courier, and a private testing firm. This chain of custody maintains the integrity of the collection and provides an effective means of deterrence, prevention, and referral for athletes. It is important to portray this slice of the program as preventive and supportive, not as punitive.

**Discipline.** Disciplinary actions for infractions of AOD-use policies must be appropriate to the infraction, clearly specified, well disseminated, and uniformly enforced. They should apply to all sports and should not be administered separately by individual coaches for individual players. Disciplinary action must be uniform for negative or undesirable behaviors, regardless of the status of the student-athlete.

**Referral and Counseling.** Procedures must be established to ensure ready access to further education, consultation and/or professional assistance for athletic department staff, and student-athletes. A trained peer mentor can refer problems appropriately; however, specific departmental policies must include procedural issues associated with referral, for example, timeliness, confidentiality, and expected follow-up.

Counseling resources should include a range of modalities compatible with athletic training and travel schedules. When athletes express the desire to join a support group or enter counseling, the athletic department must immediately make the necessary arrangements to facilitate participation, while maintaining privacy and confidentiality.

## Conclusion

The APPLE model for education and prevention is thorough and comprehensive. The peer mentor component should be expanded to give coaches, administrators, and graduate assistants an opportunity to undergo the SAM training. These vital individuals need the skills to effectively manage problems associated with AOD abuse or

its ramifications.

The APPLE plan follows the guidelines set forth by Martin and Thrasher,<sup>7</sup> Pinkerton and associates<sup>9</sup>, and Wadler and Hainline<sup>10</sup> as discussed earlier. However, the SAM program is unique to this model. The premise is that athletes will turn to their teammates or peers first when seeking help.<sup>10</sup> The SAM program can be the linchpin of effective programming: students take the responsibility and initiative in the development of prevention/education programs and in appropriate referral of their peers to counseling and rehabilitation programs.

The prevalence of alcohol and drugs in the college environment threatens the nature of pure competition, and a comprehensive approach to AOD use must meet the needs of the athletes. To offset the pervasiveness of substance use, institutions are implementing programs to uphold principles and ethics associated with competition. The institutions and organizations involved have taken "wide latitude in defending against pernicious influences, such as drug abuse."<sup>10</sup>

## References

1. Appalachian State University, Department of Athletics. *Drug Education--Screening--Counseling Program*. Boone, NC: Appalachian State University; 1990-1991.
2. Bloch SA, Ungerleider S. Targeting high-risk groups on campus for drug and alcohol prevention: an examination and assessment. *Int J Addict*. 1988; 23:299-319.
3. Blood KJ. Non-medical substance use among athletes at a small liberal arts college. *Athletic Training, JNATA*. 1990;25:335-338.
4. Burns WD. Alcohol and community: rethinking privilege. *Educ Rec*. 1989;70:54-58.
5. Duda M. Drug testing challenges college and pro athletes. *Phys Sportsmed*. November 1984;11:109-118.
6. Grossman SJ, Gieck JH, Copeland WJ. APPLE--athlete prevention programming and leadership education. *Athl Admin*. 1991;26:16-18.
7. Martin H, Thrasher D. Chemical dependency and treatment of the professional athlete. In: Lawson GW, ed. *Alcoholism and Substance Abuse in Special Populations*. Rockville Md: Aspen Publishers; 1989:315-339.
8. Massey RF, Neidigh LW. Evaluating and improving the functioning of a peer-based alcohol abuse prevention organization. *J Alcohol Drug Educ*. 1990;35:24-35.
9. Pinkerton RS, Hinz LD, Barrow JC. The college student athlete: considerations and interventions. *J Am Coll Health*. 1989;37:218-226.
10. Wadler GI, Hainline B. *Drugs and the athlete*. Philadelphia, Pa: FA Davis Company; 1989:18-33.

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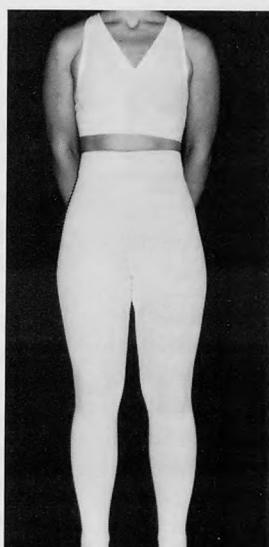
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# College Athletes and Drug Testing: Attitudes and Behaviors by Gender and Sport

Dona Schneider, PhD, MPH  
Joyce Morris, PhD, CHES

**Abstract:** We surveyed varsity athletes at a Big East university to assess attitudes toward a mandatory drug education and testing program and examined whether there were differences in drug-related attitudes and behaviors based on gender or varsity sport. We found no statistically significant differences in personal drug use behaviors based on gender or team affiliation. Attitudes about drug use and knowledge of a teammate using drugs did show significant differences based on varsity sport. Tennis players were most likely to agree that drug use by college athletes is socially acceptable. Lacrosse players were most likely to know of at least one teammate using drugs. Overall, attitudes towards the mandatory drug education and testing program were ambivalent. About half of our responding athletes believed drug testing was necessary and discouraged drug use. Only 17% believed that the program was an invasion of privacy.

In the 1980s, media accounts of drug abuse by professional, Olympic, and college players, including the drug-related deaths of several athletes, tainted the reputation of athletics.

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The National Collegiate Athletic Association (NCAA) supported several studies to determine substance use/abuse habits by college athletes.<sup>3-4,8</sup> One study of male athletes in the Big Ten conference found that 65% of upperclassmen regularly used alcohol, 22% regularly used marijuana, 7% regularly used cocaine, and 2% regularly used anabolic steroids.<sup>8</sup>

In response to these and other findings, the NCAA developed guidelines for drug education and testing programs and began random drug screening at its national championships in 1986.<sup>5,9,15</sup> Colleges and universities responded by developing their own drug education and testing programs, following NCAA guidelines.<sup>11</sup>

The mandatory nature of drug-testing programs in organized athletics, the armed forces, the workplace, and job screening prompted ethical concerns and fears of legal and social ramifications.<sup>7,10</sup> Many questioned the accuracy of drug testing. Others voiced concerns about unfair punitive actions that could result from a false positive test.

How did student-athletes react? Gaskins and deShazo<sup>6</sup> reported widespread support for drug testing of student-athletes among college nonathletes (91%), but significantly less support among athletes (46%). Abdenour et al<sup>1</sup> reported that drug testing was a deterrent to drug usage among intercollegiate football players, but that players remained concerned about testing accuracy. Athletes were less supportive

of punitive action such as suspension from the team for a positive test (49%), and more supportive of mandatory counseling for those who tested positive for drugs (73%).<sup>1</sup>

We could find no literature comparing attitudes towards drug testing among college athletes either by varsity sport or by gender. Yet, there is reason to believe that differences exist. Previous studies have documented variations in personal behaviors by both sport and gender. For example, Schneider and Greenberg<sup>12</sup> found that health risk behaviors among young adults vary, depending upon the sport. Those who chose team sports for their primary form of exercise were more likely to drink alcohol or smoke tobacco than those who chose individual sports.<sup>12</sup>

Selby et al<sup>14</sup> reported significant differences in off-season alcohol and marijuana use between male and female college athletes. Anderson et al<sup>2</sup> replicated a 1985 study of alcohol and drug use by college athletes and found decreases in the use of cocaine, marijuana, and amphetamines, but increased use of smokeless tobacco and pain medications. They reported differences in substance use for five male and five female varsity sports.<sup>2</sup>

Given that drug use behaviors differ by both sport and gender, we expected that attitudes towards a mandatory drug education and testing program would vary accordingly.

## Methods

We distributed 524 surveys to the mailboxes of varsity athletes whose names appeared on 12 varsity team rosters. The survey instrument asked age, gender, and team membership. It also contained 22 questions about personal drug use behaviors (including alcohol), knowledge about drug use among teammates, opinions about the drug education and testing program for varsity athletes, and their feelings on whether testing programs are effective or a violation of their right to privacy. All surveys were anonymous. We requested that completed surveys be returned to the student mailbox of a varsity athlete who was also a member of our research team.

Responses were entered into a database and tabulated by gender and team affiliation. Two athletes participated in more than one varsity sport. Their primary sport was used for tabulation purposes. Chi-square analyses were performed to test for differences between groups and p-values were noted. We interpreted p-values  $\leq .05$  as statistically significant.

## Results

Of the 524 surveys distributed, 197 (38%) were returned. One hundred forty-two (72%) respondents were male and 55 (28%) were female. Ages ranged from 19 to 20 years (45%) to 23 to 24 years (4%).

Male respondents represented six varsity teams—baseball, basketball, football, lacrosse, soccer, and track. Females represented another six—basketball, field hockey, soccer, softball, tennis, and track. The distribution of responses by team and gender appears in Table 1.

## Behaviors and Attitudes About Drug Use

Although 95% of the respondents were aware of the university's mandatory drug education and testing program for athletes, 24 (12%) claimed to be using banned substances (including alcohol) one or more times a month. Differences in use of banned substances based on gender or team affiliation were not statistically significant at  $p \leq .05$ .

Eighty (41%) athletes said drug use is socially acceptable in college. Only 28 (14%) said drug use by athletes should be acceptable in college. There were significant differences between responses based on team affiliation ( $p < .0005$ ), with five of six tennis players (83%) saying: "Yes, drug use by athletes should be acceptable in college," and baseball (16), field hockey (11), and softball (11) players unanimous in saying: "No, it should not be acceptable."

Athletes claiming to have experimented with illegal substances while in college numbered 112 (57%), but differences by gender and between teams were not statistically significant at  $p \leq .05$ . For those who had experimented, only 11 (10%) said they had

**Table 1.—Number of Varsity Athletes Responding by Gender and Sport.**

Sport	Responses	
	Male	Female
Baseball	16	0
Football	56	0
Lacrosse	21	0
Basketball	8	6
Soccer	16	11
Track	25	10
Field Hockey	0	11
Softball	0	11
Tennis	0	6
<b>Total</b>	<b>142</b>	<b>55</b>

experimented for purposes of performance enhancement. The remaining 101 (90%) claimed they experimented for social or peer pressure reasons. Again, there were no statistically significant differences by gender or between teams.

Eighty-five (43%) claimed to know of at least one teammate using illegal substances. Males were more likely than females to know of drug use by a teammate ( $p \leq .0001$ ). Differences among teams were also statistically significant ( $p < .0005$ ), with Lacrosse players most likely to know that a teammate was using banned substances (18 (86%)), and softball and tennis players

least likely to have such knowledge (18% and 17%, respectively) (Table 2).

## Attitudes About Drug Testing

One hundred eighty-eight (95%) of the respondents were aware of the university's mandatory drug testing program when they signed up for their varsity sport, but only 112 (57%) knew which drugs were being tested. There were statistically significant differences ( $p < .02$ ) between team players who knew which drugs they were being tested for and those who did not. For example, 10 (90%) lacrosse players knew which substances were being tested, but 8 (73%) of the field hockey

**Table 2.—Responses to "Are You Aware of Any Teammate Using Illegal Substances" by Sport.**

Sport	Yes		No	
	n	%	n	%
Baseball	5	31	11	69
Football	31	55	25	45
Lacrosse	18	86	3	14
Basketball	7	50	7	50
Soccer	8	30	19	70
Track	9	26	26	74
Field Hockey	4	36	7	64
Softball	2	18	9	82
Tennis	1	17	5	83
<b>Total</b>	<b>85</b>	<b>43</b>	<b>112</b>	<b>57</b>

$\chi^2 = 31.17, p < .0005$

players did not.

We asked if drug testing discourages drug use by athletes. The results were mixed, with 111 (56%) athletes responding "yes," and no statistically significant differences by gender or across sports.

We asked if random drug testing was necessary. Only 96 (48%) said yes. We asked if athletes should be informed of the date of their test. Only 56 (29%) said yes. Eighty-nine (45%) felt that drug testing should be done weekly, an additional 82 (42%) said monthly, and 26 (13%) said only once during the season. In response to whether drug testing is an invasion of privacy, only 31 (17%) said yes. There were no statistically significant differences in responses between teams or between males and females for any of the above questions about attitudes towards drug testing.

We asked whether the penalty for a positive drug test was severe enough. One hundred two (52%) responding athletes said yes, but there were statistically significant differences ( $p < .0005$ ) between teams (Table 3). Soccer players were most likely to disagree that penalties were severe enough (11 (41%)), whereas no basketball players disagreed.

In response to whether all sports should be tested equally, 140 (71%) athletes felt all sports should be, but there were significant differences between male and female athletes ( $p = .03$ ). Male

athletes were more likely to agree, and female athletes were more likely to disagree that there should be equality in testing.

## Discussion

We hypothesized that there would be differences in the drug use behaviors and attitudes about drug testing of varsity athletes based on gender and sport. For personal drug use behaviors, we found no statistically significant differences based on gender or team affiliation.

Overall, 24 (12%) responding athletes claimed to be using drugs (including alcohol) once a month or more. In a previous study of undergraduates at this university, we found once a month or more drug use (including alcohol) among our general student population to be 92%.<sup>13</sup> These findings are consistent with those of Anderson et al,<sup>1</sup> who showed that rates of drug use among college athletes are lower than among college students in general.

Only 9 (<5%) responding athletes claimed to have tried drugs as a performance enhancer. This finding is similar to that of Anderson et al,<sup>2</sup> who found ergogenic drug use among football players to be about 6%, but far lower than among athletes in other varsity sports (males: baseball (15%), basketball (27%), tennis (73%), track/field (15%); females: basketball (40%), softball (36%), swimming (27%), tennis

(70%), and track/field (28%)).

In summary, we found that varsity athletes had lower rates of drug use than the general college population, and that they used far fewer drugs perceived as ergogenic than might have been expected based on the results of a previous study. This finding held across sports and for both males and females.

We did find statistically significant differences in attitudes about the social acceptability of drug use among athletes ( $p < .05$ ). Twenty-eight (14%) athletes felt that drug use among athletes is socially acceptable in college, and our tennis players were the most likely to agree. This finding is in line with those of Gaskins and deShazo<sup>6</sup> that 19% of the University of Alabama athletes considered occasional use of drugs at social events acceptable.

Attitudes about the mandatory drug education and testing program were mixed, with few statistically significant differences based on gender or team affiliation. Our strongest finding was that males were for equality in testing, whereas females were not. Anecdotal information obtained from the locker room of male varsity players by the student-athlete member of our research team revealed that players knew they were playing by the drug-free rules and they just wanted to be sure everyone else was, too. In addition, players felt coaches and trainers should be tested. Strong feelings that role models should be subjected to the same rules as players were voiced.

Our general findings about attitudes towards drug testing did not mirror those of prior studies. For example, Abdenour et al<sup>1</sup> found that 264 (63%) football players in Division I felt drug testing discourages the use of drugs. Only 110 (56%) of our responding varsity athletes felt similarly ( $p = .01$ ). Anderson et al<sup>2</sup> found that 65% of college athletes at 11 institutions felt drug testing was necessary. We found that only 95 (48%) of our responding athletes believed this to be so ( $p < .0001$ ). Invasion of privacy was a concern to 72% of the athletes at the University of Alabama in 1985, a period when drug testing was just beginning at many colleges and universities across the United States.<sup>14</sup> We found only 33 (17%)

**Table 3.—Responses to "Is the Penalty for Drug Use Severe Enough?" by Sport.**

Sport	Agree		Neutral		Disagree	
	n	%	n	%	n	%
Baseball	11	69	3	19	2	13
Football	42	75	10	18	4	7
Lacrosse	13	62	7	33	1	5
Basketball	5	36	9	64	0	0
Soccer	6	22	10	37	11	41
Track	18	51	9	26	8	23
Field Hockey	3	27	5	45	3	27
Softball	2	18	5	45	4	36
Tennis	2	33	3	50	1	17
Total	102	52	61	31	34	17

$\chi^2 = 48.30, p < .0005$

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responding athletes considered mandatory drug testing an invasion of privacy ( $p < .0001$ ).

The differences in our findings and those of prior studies might spring from several factors. There is the possibility of regional bias, in that we were surveying athletes from one Eastern university rather than from the South or a cross-regional sampling as was done for the NCAA studies.

There is also the possibility of selection bias. The athletes who responded might hold different views about drug testing than their teammates who did not respond. For example, we did not control for class status. Our head trainer notes there are vast differences in the reactions to drug testing between freshmen and returning varsity players. Returning players take drug testing in stride, whereas freshmen are nervous, often to the point of being unable to provide a specimen. He also notes that football and basketball players are tested far more frequently than players of other varsity sports. Because they are tested so frequently and because they are subjected to a more intense drug education program, they may hold different views on the drug testing program than other varsity athletes.

Finally, this study may accurately reflect the attitudes of our varsity athletes about the mandatory drug educa-

tion and testing program which has now been in place for more than half a decade. They are simply indifferent. This may be because the program has been in effect for several years and the current cohort of athletes has never known a varsity athletic program without drug education and testing. It may be due to the way the program is run, with a focus on education rather than on punitive actions, or it may be a reflection of the matter-of-fact personalities of the coaches and trainers. The reality is, however, that the program does not seem to concern or offend our varsity athletes of either gender or across sports.

To test whether these results can be generalized, a multi-institutional study comparing attitudes about drug education and testing programs and personal drug use behaviors by gender and sport should be done. In addition, it would be useful to know if the attitudes and behaviors of athletes differ not only by gender and sport, but also by level of athletic programs for different divisions, or for different geographic areas. This knowledge will allow coaches and trainers to target their drug education and testing programs for maximum effect.

## References

1. Abdenour TE, Miner MJ, Weir N. Attitudes of intercollegiate football players toward drug testing. *Ath-*

- letic Training, JNATA*. 1987;22:199-201.
2. Anderson WA, Albrecht RR, McKeag DB, Hough DO, McGrew CA. A national survey of alcohol and drug use by college athletes. *Phys Sportsmed*. February 1991;19:91-104.
3. College of Human Medicine. *The Substance Use and Abuse Habits of College Student Athletes*. (Research Paper #2. General Findings. Report to the NCAA.) East Lansing, Mich: Michigan State University; 1985.
4. College of Human Medicine. *Replication of the National Study of the Substance Use and Abuse Habits of College Student-Athletes*. (Final Report to the NCAA.) East Lansing, Mich: Michigan State University; 1989.
5. Duda M. Drug testing challenges college and pro athletes. *Phys Sportsmed*. November 1984;12:109-118.
6. Gaskins SE, deShazo WF. Attitudes toward drug abuse and screening for an intercollegiate athletic program. *Phys Sportsmed*. September 1985;13:93-100.
7. Montagne M, Pugh CB, Fink JL. Testing for drug use, part 2: legal, social, and ethical concerns. *Am J Hosp Pharm*. 1988;45:1509-1522.
8. National Collegiate Athletic Association. *General Comments*. Overland Park, Kan: NCAA Drug Education Committee; 1982.
9. National Collegiate Athletic Association. *1990/91 NCAA Drug Testing/Education Programs*. Overland Park, Kan: NCAA Publishing; 1990.
10. Pickett AD. Drug testing: what are the rules? *Athletic Training, JNATA*. 1986;21:331-336.
11. Rutgers University Department Intercollegiate Athletics. *Substance Abuse Program*. New Brunswick, NJ: Rutgers University; 1991.
12. Schneider D, Greenberg MR. Choice of exercise: a predictor of health risk behaviors? *Res Q Exerc Sport*. 1992;63:1-7.
13. Schneider D, Morris J. Risk-taking behaviors of college students. *Environ Behav*. 1991;25:575-591.
14. Selby R, Weinstein HM, Bird TS. The health of university athletes: attitudes, behaviors, and stressors. *J Am Coll Health*. 1990;39:11-18.
15. Wagner JC. Substance-abuse policies and guidelines in amateur and professional athletics. *Am J Hosp Pharm*. 1987;144:305-310.

## Oral Presentations

Session #1—Friday, June 11  
Educational Research: 8:00-9:00 am

### 1992 Entry-level Salaries for Athletic Trainers

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

The purpose of this study was to examine the salaries of the clinic, high school, and college/university for entry-level athletic trainers during the year 1992. Entry-level was defined as an athletic trainer, certified by the National Athletic Trainers' Association, with no experience. A master's degree was required for college/university placement. According to the "Placement Vacancy Notice" published by the National Athletic Trainers' Association, there were 137 entry-level vacancies in the college/university, 57 in the high school, and 241 in the clinical setting. A survey was designed and mailed to these 435 vacancies. Percentage return was 39% (53), 39% (22), 34% (82) for college/university, high school, and clinic, respectively. The following table represents the rank order of entry-level annual salaries according to job description:

	Annual Salary	
	BS	MS
1. High School Athletic Trainer/Teacher	27,581	29,453
2. Clinic Athletic Trainer	22,949	25,381
3. Clinic Athletic Trainer/High School	22,608	25,300
4. College/University Athletic Trainer/Teacher	21,765	24,383
5. High School Athletic Trainer	21,046	24,785
6. College/University Assistant Athletic Trainer	19,263	22,769

Overall, entry-level salaries for athletic trainers were \$23,065 ( $\pm 4,635$ ;  $n=110$ ) for a bachelor's degree (BS) and \$25,368 ( $\pm 5,826$ ;  $n=130$ ) for a master's degree (MS). Most of the high school positions included a stipend with the annual salary. Term of contract for high school and colleges/universities ranged from 9 to 12 months, while clinic positions were always considered a 12-month contract. Further studies are recommended to establish salary norms and trends for entry-level positions.

# Abstracts of 1993 NATA National Convention Free Communications

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### A Multi-case Study of First Year Athletic Trainers at the High School Level

Curtis N. William Paterson College of New Jersey, Wayne, NJ 07470

The purpose of this study was to investigate and describe the experiences of four first-year athletic trainers working at the high school level. A secondary purpose was to draw implications for athletic training preparation programs and for high schools employing athletic trainers. Standard qualitative research methods were used to accomplish these purposes. Data were collected over a 6-month period from live observations, formal and informal interviews, document analysis, and log notes. Data were transcribed and formatted for analysis using word processing software to simulate the Ethnograph computer program. Four case narratives were written describing the first year for each athletic trainer as they experienced it. Each case was written identifying emergent themes unique to each athletic trainer. A cross-case analysis was conducted to identify commonalities, and differences among the four athletic trainers. The results indicated the novice athletic trainers, in general, felt prepared to perform their duties at the high school. However, much of what they learned and practiced in their undergraduate experiences were not necessarily what they encountered in the "real" world of high school athletic training. Each athletic trainer's job performance was clearly influenced by the: "fitting in" process encountered during the first year; dual job responsibilities; available

facilities and equipment; level of support from the athletic director; and peer support received. They performed the six NATA major tasks in varying amounts, and in an integrated and sequential manner. The tasks of prevention, evaluation, and treatment were performed most frequently, and rehabilitation relatively infrequently. The largest proportion of time was spent covering athletic practices and games. This duty, along with the duties of preparation, equipment repair, and security did not fit neatly into one of the six major tasks. Recommendations for preparation programs include: provide high school athletic training experience for advanced students; include subject matter covering the adolescent athlete; present the tasks in an integrated approach; address the realities of athletic training; provide information on state regulation; and provide increased opportunities for hands-on techniques. Recommendations for high schools and beginning athletic trainers also are presented.

### Current Status of Graduates From NATA-approved Undergraduate Athletic Training Programs in the State of Pennsylvania

Marks M, Sitler M, Yost C. Temple University, Philadelphia, PA 19122

The purpose of this study was to determine the demographic makeup, professional preparation, current employment settings, work parameters, and level of job satisfaction of graduates

from the eight NATA-approved undergraduate athletic training programs in the state of Pennsylvania. A questionnaire was developed and mailed to 860 graduates in 1990-1991, and a total of 377 (44%) responses were returned by 182 (49%) males and 195 (51%) females. On average, the respondents were 30.6 years old (males=31.8, females=29.7) and graduates for 8.0 years (males=8.6, females=7.2). Approximately 88% of the high school, collegiate, and clinical trainers reported having been adequately prepared academically for their current employment setting. Clinical preparation was perceived as being appropriate for 78% of the high school, 85% of the collegiate, and 67% of the clinical trainers. Sixty-nine (46%) of the respondents held masters degrees and, of these, 40 (58%) anticipated pursuing a doctorate. Hierarchy of job satisfaction by employment setting was as follows: college trainers were least satisfied, citing dissatisfaction with salary, advancement opportunities, stress, and number of hours worked; high school trainers were generally satisfied, citing discontent with career advancement; and clinical trainers were most satisfied, citing moderate concern with salary and advancement opportunities. Seventy percent of the respondents employed as athletic trainers reported that they again would choose athletic training as their career. Of 94 (24%) respondents, 48% had worked 3 years and 75% had worked 5 years as athletic trainers, but were not employed currently in the profession. The present work settings for these individuals were predominately in people-service professions. Retrospectively, 48% of these respondents indicated that they again would choose athletic training for their career pathway. Primary reasons for leaving the athletic training profession cited by males were excessive time commitment, limited salary, and lack of advancement; females cited lack of personal and family time due to excessive on-job time demands. The importance of this study is that it identifies diversified issues, which confront the athletic training profession as it emerges into the 21st century.

## **Athletic Training Continuing Education Needs Assessment**

Weidner TG. Ball State University, Muncie, IN 47306

Continuing education for certified athletic trainers is both required and essential. The purpose of this study was to determine the need, solutions to the need, and the priority of the solutions to the need regarding continuing education for athletic trainers in various employment settings. Focus group sessions (60 minutes in length) were conducted during a Spring 1992 district meeting of the National Athletic Trainers' Association. Representatives for each of the following employment settings were selected randomly from the preregistration list and invited to participate: high school (7 participated), college/university (8 participated), corporate/industrial (6 participated), professional (3 participated), and clinical (8 participated). Data were analyzed using descriptive statistics. Focus group participants across all employment settings felt that their primary continuing education needs were not being addressed at the district meetings. Less traditional topics (eg, ergonomics, budgeting, public relations, functional capacity evaluations) were identified as the more essential education needs. Various group differences and similarities were observed regarding specific topics and their methods of presentation. Recommendations included a more thematic approach to topics and presentations and ample opportunities for work or discussions in small groups. Results of the focus groups could impact the professional preparation of athletic trainers.

**Session #2—Friday, June 11  
Clinical Studies: 9:15-10:15 am**

## **The Clinical Effectiveness of a Semirigid Ankle Brace to Reduce Acute Ankle Injuries in Basketball**

Sitler M, Ryan J, Wheeler B, McBride J, Arciero R, Anderson J, Horodyski M. United States Military Academy, West Point, NY 10996

The purpose of this prospective, ran-

domized 2-year study was to determine the efficacy of a semirigid ankle brace (SAB) to reduce the frequency and severity of acute ankle injuries in an athletic environment in which the athletic shoe, playing surface, athletic-exposure (AE), ankle injury history, and brace assignment were controlled either statistically or experimentally. The study was conducted in the intramural basketball program at the United States Military Academy, West Point, NY. A total of 1601 subjects participated in the study. With every player participating in a practice or game counted as one AE, a total of 1601 AE occurred during the 2 years of the study (1990 and 1991). The subjects' average height and weight were 69.4 inches and 165 pounds. Each subject had 2.08 years of experience playing organized basketball and was 19.25 years old. An ankle injury was defined as acute trauma to the ankle ligaments that resulted in an athlete's inability to participate in basketball 1 day after the injury. Injury diagnosis was rendered by an orthopaedic surgeon, usually within 24 hours of the injury. During the study, 46 subjects sustained ankle injuries. This was an injury rate of 3.4 per 1000 AE. A significantly greater number of ankle injuries ( $p < .01$ ) occurred in the unbraced control group (35) than in the SAB group (11). The most common injury was to the anterior talofibular (ATF) ligament and occurred 39 times (66%). The next most common injury was to the calcaneofibular (CF) ligament which occurred 10 times (17%). A significantly greater number of ATF ligament injuries ( $p < .05$ ) occurred in the control group (30) than in the SAB group (9). A significant difference ( $p < .0001$ ) also existed in the number of CF ligament injuries between the SAB group (0) and control group (10). Incidence of ankle injury by position (guard, forward, center) was independent of brace assignment. Injury severity was not reduced statistically, but ankle injuries tended to be less severe for SAB subjects than control subjects. Frequency of knee injury was unaffected by wearing of the SAB. In summary, within the constraints of proper brace application and use, and the specific model used, SABs signifi-

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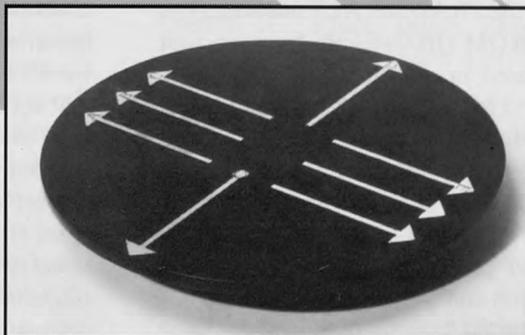
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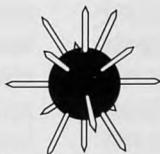
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cantly reduce the frequency of ankle injuries in basketball, but not the severity of injury.

### **Validity and Reliability of an Alternate Method of Measuring Subtalar Joint Inversion and Eversion**

Dolan MG, Tonsoline PA, Bibi KW, Reeds GK. The Human Performance Laboratory, Canisius College, Buffalo, NY 14208 and Buffalo Physical Therapy and Sports Care Services, Buffalo, NY 14223

The purpose of this study was to determine the validity and reliability of an alternate method of measuring subtalar joint inversion and eversion. Subtalar joint measurements are used in the clinical examination of the foot and in the eventual fabrication of foot orthotic devices. The measurement typically is taken using the traditional (TRAD) two-handed method. The alternate (ALT) method, a one-handed technique, allows one hand to manipulate the goniometer and the other hand to move the subtalar joint into inversion and eversion. Forty high school athletes, 21 males and 19 females (age=15.3±0.5 yr; height= 167.5±10.2 cm; weight=59.0±11.8 kg), served as subjects for this study. Using blinded goniometers, two clinicians measured each subject for subtalar joint inversion (INV) and subtalar joint eversion (EVR) using the TRAD and ALT methods. The total ROM (INV+EVR) for each foot was used in the analysis. The TRAD method involves placing the stationary arm of the goniometer on the bisection of the lower 1/3 of the leg, and the movable arm aligned with the bisection of the calcaneus. The calcaneus then is moved passively into inversion and eversion and the measurements recorded. The ALT technique uses the same landmarks as the TRAD, while allowing the clinician to hold the goniometer with one hand, releasing the other hand to freely manipulate the calcaneus. The subjects were assigned randomly to all tester and treatment conditions. In all of the hypothesis testing, the .05 level of probability was used. To determine the validity of the ALT method, differences between the means were analyzed using

a t-test for correlated samples. No significant differences were found between the TRAD and ALT methods for the right foot for both clinicians. While no significant differences were found for the left foot for clinician 1, there was a significant difference for clinician 2 (a difference of 1.2°). Intrarater reliability (TRAD to ALT) for clinician 1 was 0.68 and 0.89 for left and right foot, respectively. Clinician 2 yielded intrarater reliability values of 0.89 and 0.88 for left and right foot, respectively. Interrater reliability coefficients of 0.50 and 0.82 were computed for the right and left foot, respectively, using the TRAD method, and 0.84 and 0.89 for the right and left foot, respectively, using the ALT method. In conclusion, the one-handed alternate method proved to be valid and reliable for assessing subtalar joint inversion and eversion.

### **Effect of the Swede-O Ankle Brace on Subtalar Joint Displacement in Subjects With Unstable Ankles**

Carroll MJ, Rijke AM, Perrin DH. University of Virginia, Charlottesville, VA 22903

This study examined the effect of the Swede-O ankle brace on subtalar joint displacement in subjects with an unstable ankle joint. A Telos GA II/E stress tester and radiography were used to determine talar tilt. Six college-aged females (age=25.4 yr, ht=163.1cm, wt=63.5 kg) with talar tilts greater than 9.5° at 15 kilopascals (kp) of pressure on the Telos stress test device participated in the study. Prior to participation, each subject read and signed an informed consent form approved by an institutional review board for the use of human subjects and a committee on radiological investigation. Each subject then was x-rayed at five pressure conditions (0, 6, 9, 12, & 15 kp) with a bare ankle. The x-ray series then was repeated with the subjects wearing a Swede-O ankle brace. A one-way ANOVA with repeated measures was computed for the statistical analysis. Mean bare ankle talar tilt angles differed significantly ( $p<.05$ ) at each pressure from 0° of pressure. Mean displacements were 8.15°,

10.35°, 11.90°, and 13.12° at 6, 9, 12, and 15 kp of pressure, respectively. After application of the ankle brace, the talar tilts varied significantly ( $p<.05$ ) from 0° of pressure at 9, 12, and 15 kp of pressure with mean values of 8.47°, 11.08°, and 12.77°, respectively. No difference was found for 6 kp of pressure. These findings suggest that at higher pressures of forced inversion, the Swede-O ankle brace is not effective in reducing subtalar joint displacement in subjects with unstable ankles. Any effectiveness of the brace may be due to other factors, such as proprioceptive feedback during inversion. The role of the Swede-O ankle brace as a prophylactic or stabilizing device in subjects with healthy and unstable ankles deserves further investigation.

### **Effects of a Four-week Euroglide Program on Hip Abduction/Adduction Measured by Computerized Isokinetic Testing**

Broderick KS, Molinar LS, Merrifield HH. Texas Tech University Health Science Center, Lubbock, TX 79424

The purpose of this study was to examine the effects of a 4-week Euroglide training protocol on concentric isokinetic values of peak torque and average power obtained in the test pattern of hip abduction/adduction. Eighteen healthy subjects (age=22±2.7 yr) were assigned randomly to a training group (n=12) or a control group (n=6). The Euroglide training protocol was performed 3 days per week for 4 weeks. The program progressed in intensity by adjusting the board length, time spent sliding, and training heart rate. All subjects were pretested and posttested on a Cybex 340 isokinetic dynamometer at velocities of 90 and 120 per second. Independent t-tests were performed on the mean differences between the two groups. An alpha level of .05 was considered statistically significant. Peak torque data revealed significant main effects for test, movement, and degree. The independent t-tests revealed significant differences between the experimental and control groups at the following specific variables of leg,

movement, velocity, and strength measure. The left leg adductors at both 90°/s and 120°/s for average power were found to be significant for the experimental group. In addition, the right leg adductors at 120°/s for the measurement of peak torque were also found to be significant. An overall trend of improvement (peak torque and average power gains) from pretest to posttest measures was noted in the descriptive data. Based on the current study, it can be concluded that training on the Euroglide is an effective means of increasing torque and power of abductor and adductor musculature of the lower extremity.

**Session #3—Friday, June 11**  
**Basic Science: 10:30-11:45 am**

### **Force Absorption in Football Shoulder Pads: A Biomechanical Assessment**

Deppen D, Noble L, Walker H, Dorgan R. Kansas State University, Manhattan, KS 66506

Manufacturers' claims regarding the performance of protective equipment demand that athletic training, as a profession, examine more closely objective criteria. A literature search revealed no definitive or objective criteria for the evaluation of football shoulder pad performance. The purpose of this study was to compare both objective and subjective data regarding the performance of the more commonly used shoulder pads. Pads consisted of both closed-cell and open-cell (one- and three-layer) foam. The shoulder pads examined represented a cross section of the most commonly used brands and included both high school and professional models. Four subjects experienced in high school football wore each pair of pads while impacting the sled several times. Data was obtained and analyzed using the following: force-sensing resistors, Analog-to-Digital interface board, digital computer, strain gauge, wall-mounted hitting sled, and subjective performance questionnaire. Total impact force and perceived protective effectiveness were assessed through objective and subjective data obtained in both laboratory and

field tests. Results indicated that: 1) in all instances, the greatest force was placed upon the acromion process; 2) the player-preferred pad in both field and laboratory tests corresponded to the pad that proved most effective in preventing peak impact forces; 3) shoulder pads using an open-cell air-management system resulted in lower peak impact forces when compared with closed-cell pads; and, 4) shoulder pads using three-layer open-cell foam were not superior to those using one-layer open-cell foam in preventing peak impact forces. An analysis of covariance was performed removing the effect of total impact force. NOTE: This study was funded partially by the Kansas State University Research Foundation

### **Isotonic Contractions May Be More Effective Than Isokinetic Contractions in Developing Muscle Strength**

Knight KL, Ingersoll CD. Sports Injury Research Lab, Indiana State University, Terre Haute, IN 47809

The theory of isokinetics has remained virtually unchallenged since its inception in the 1960s, even though most conditioning programs use isotonic equipment. An analysis of internal and external forces generated during multiple isokinetic and isotonic contractions suggests that isotonic lifting provides a greater stimulus for strength development, especially during rehabilitation. The basis of isokinetics is that accommodating resistance provides greater average resistance during an individual contraction because it is not limited by the sticking point. During multiple repetitions, however, as the muscle fatigues, the resistance decreases proportionally with fatigue. Because the resistance is constant during an isotonic contraction, though, as the muscle fatigues, it must either recruit additional motor units or fail to complete the repetition. If extra motor units are recruited at the point of fatigue, it would represent a major advantage for isotonic strength training and may be more important to developing strength than the greater resistance during early isokinetic repetitions when

the muscle is fresh. To test this hypothesis, we had subjects perform 25 maximal effort isokinetic repetitions of knee extensions at 60°/s on a Kin-Com. Following 25 to 72 hours rest, they performed maximal repetitions isotonicly (force mode) on the Kin-Com using 70% of the isokinetic peak torque and with speed set at a maximum of 300°/s. We computed peak and average force of the first and last three isotonic repetitions and the corresponding isokinetic repetitions. Peak force during the first three repetitions was 16% greater isokinetically, but average force was similar. During the last three repetitions, isotonic force was higher than isokinetic: 12% to 20% for peak force and 25% to 66% for average force. Also, the isotonic torque curves during the last 3 repetitions were higher and much broader. These data support the hypothesis that the muscle is more active as it nears fatigue during an isotonic contraction, and that it recruits extra motor units. These attributes are especially important during rehabilitation when redeveloping strength depends on overcoming neural inhibitions.

### **Strength, Speed, and Power Gains With Isokinetic Training Versus Isotonic Training With the Dapre Technique**

Olson KD, Knight KL, Ingersoll CD, Ozmun JC. Sports Injury Research Laboratory, Indiana State University, Terre Haute, IN 47809

Isotonic and isokinetic exercise are used frequently in rehabilitation and training to increase strength and restore normal muscle function. Their relative effectiveness in developing strength, speed, and muscular power has not been established. The purpose of this study was to determine whether isotonic training with the Daily Adjustable Progressive Resistive Exercise (DAPRE) technique and speed sets or isokinetic training produces greater gains in strength, speed, and muscular power over a 4-week training period. Thirty healthy college students were assigned randomly to one of four training groups: 1) isokinetic training at 60°/s (IK60), 2)

IK at 180°/s (IK180), 3) IK with a velocity spectrum (IKVS), and 4) isotonic training with the DAPRE technique for 3 weeks and speed sets for 1 week (IT). Training occurred three times per week for 4 weeks, on either a Universal machine (isotonic), or an Orthotron Exercise System (isokinetic). Subjects in the isokinetic training groups performed 3 sets of 10 repetitions during each training session. Subjects were pretested and posttested for isotonic strength; isokinetic strength at 60°/s, 120°/s, 180°/s; speed; and muscular power. The data were analyzed using separate univariate ANOVAs (with a corrected ) for each dependent variable and a Pearson correlation of the functional strength increase (change in weights lifted isotonicly) of the isotonic training group with each of the four KINCOM strength measures. The IT group increased 97% in functional strength, while the four KINCOM tests indicated increases between 7% and 56% in peak torque and between 11% and 68% in average torque (IT—IK60, IK120, IK180). The four KINCOM tests indicated increases of 0% to 29% in peak torque and 2% to 31% in average torque in the IK60 group, 2% to 99% in peak torque and 7% to 141% in average torque in the IK180 group, 1% to 5% in peak torque and -2% to 8% in average torque in the IKVS group. The statistical power of the study was low (0.2), however, so the statistical tests were not able to distinguish any differences between the four training groups. There was no correlation between functional strength and any of the KINCOM tests ( $r=.34$ ,  $p=.70$ ). Therefore, we question the validity of the KINCOM as an instrument for measuring functional strength (as reflected by quadriceps ability to lift increasing amounts of weight).

### **The Role of Pronation in Patellofemoral Stress Syndrome**

Moss RI. Western Michigan University, Kalamazoo MI 49008

Abnormal pronation is mentioned often as a causative factor in lower extremity pathology and, in particular, patellofemoral stress syndrome (PFSS).

However, the question often arises: "What is abnormal pronation?" This study was performed in order to quantify the relationship between pronation and PFSS. Twenty-nine high-school-aged females, 14 with either unilateral or bilateral PFSS, and 15 without PFSS were filmed while running on a treadmill at an 8-minute mile pace. Temporal and kinematic data regarding pronation were obtained. Student's t-tests revealed the following at the .05 level of probability: 1) there was no significant difference in maximum excursion of pronation between those with PFSS and those without PFSS, 12.3° and 12°, respectively, and 2) there was a significant difference in the amount of time it took to reach maximum pronation between those with PFSS and those without PFSS, .106s and .094s, respectively. One may infer from this that the timing, or synchronization of movements of those structures involved in pronation is a critical factor in those with PFSS. Applying these data would encourage the athletic trainer to scrutinize the structures responsible for controlling or synchronizing the movements which lead to pronation. In general, the muscles which decelerate the chain of movement from the foot to the hip should be analyzed.

### **The Effects of Ice and Elastic Wraps on Intratissue Temperatures at Various Depths**

Merrick MA, Knight KL, Ingersoll CD, Pottelger JA. Indiana State University, Terre Haute, IN 47809

While ice and compression wraps are used commonly to treat musculoskeletal injuries, the literature describing intramuscular temperatures has not addressed the combination of ice and compression wraps. The purpose of this study was to evaluate intramuscular temperatures at three sites (skin surface, 1 cm, and 2 cm below the fat layer), using both ice and compression wraps. Temperatures were recorded in 11 subjects (7 males, age=23.9±2.5 yr, ht=181±6.2 cm, wt=49.4±6.6 kg, thigh skinfold=15.4±4.1 mm; 4 females, age=22.8±0.5 yr, ht=165.5±8.4 cm, wt=37.4±7.3kg, thigh skinfold=16.5

±3.4 mm) with an isothermex using implantable and surface thermocouples. Each subject was tested under four treatment conditions: control, compression only, ice only, and ice + compression, according to a balanced latin square. Surface and intramuscular temperatures were recorded at 30-second intervals during 5 minutes of preapplication, 30 minutes of application, and 20 minutes of postapplication. A repeated measures ANOVA and Duncan Post Hoc tests were used to evaluate temperature differences between the treatment conditions and the depths of measurement. Both ice alone and ice + compression produced significant cooling at all three depths ( $F(6,60)=168.5$ ,  $p<.0005$ ). Likewise, during the 20-minute postapplication period, these temperatures did not return to their preapplication levels. The compression-only condition produced significant warming at the skin surface, but did not have any effect on intramuscular temperature. At all depths, the ice + compression condition produced significantly cooler temperatures than did ice alone. We suggest that compression increases the effectiveness of ice in reducing tissue temperatures. Therefore, ice combined with compression should be more effective than ice alone in reducing the metabolism of injured tissue. This study provides an additional rationale for combining ice with compression in treating acute musculoskeletal injuries.

**Session #4—Friday, June 11**  
**Basic Science/Clinical Studies:**  
**1:30-2:45 pm**

### **A Comparison of Two Intermittent External Compression Devices on Pitting Ankle Edema**

Lemley TR, Prentice WE, Hooker DH, Shields EW. University of North Carolina—Chapel Hill, Chapel Hill, NC 27514

The purpose of this study was to compare the effectiveness of two treatments in reducing pitting ankle edema. One group was treated with the Jobst Cryo/Temp (JCT); the other group was treated with the Wright Linear Pump (WLP). A third group was treated with

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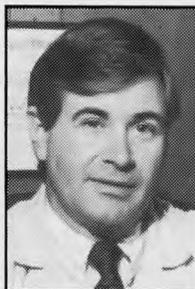
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elevation and acted as a control group. Water displacement measurements were taken before and after one 30-minute treatment as an indirect method to calculate the effects on pitting ankle edema. Twenty-seven college-aged male and female subjects were evaluated by a graduate/staff athletic trainer or by a physician in the University of North Carolina Student Health Service. To meet requirements for the study, subjects presented a unilateral ankle sprain, with pitting edema, that did not require cast immobilization or surgery. Subjects were assigned alternately to the three treatment groups and were treated at least 24 hours postinjury. A significant repeated measures effect was found ( $p < .0001$ ); however, no significant effects were found for either treatment condition ( $p < .5091$ ) or interaction ( $p < .307$ ). Seven out of nine subjects in both the WLP and JCT groups experienced a reduction greater than the measurement error calculated for the volumetric water displacement tank (7.08 ml), while only four out of nine subjects in the control group experienced a reduction greater than 7.08 ml. Thus, both the WLP and the JCT were found to be of greater clinical benefit than elevation alone in reducing pitting ankle edema. The mean reduction values for the WLP and JCT groups were -9.667 ml and -13.556 ml, respectively. Therefore, this study suggests that the JCT is the treatment of choice for reducing pitting ankle edema.

### **The Effects of Closed-head Injury on Postural Sway**

Ingersoll CD. Sports Injury Research Laboratory, Indiana State University, Terre Haute, IN 47809

Decisions to return athletes to competition following closed-head injury often are based on subjective neurological examinations. The function and integration of the sensory modalities that control posture are not usually evaluated prior to release to competition. The purpose of this study was to determine the effects of closed-head injury on postural sway under conditions of sensory modality confusion and/or elimination. Forty-eight subjects (26 males and 22 females) between the ages

of 18 and 45 were divided equally into four groups corresponding to their level of head injury. Group 1 members never incurred a head injury; group 2 members incurred head injuries without loss of consciousness; group 3 members lost consciousness for 6 hours or less; and group 4 members were unconscious for greater than 6 hours. All subjects were at least one year postinjury and had been released from therapy, if applicable. Each subject performed three trials of six variations of the Romberg test on a force platform. The center of pressure transmitted through the bottom of the feet was monitored during each 30-second trial. Total, anterior-posterior (AP), and medial-lateral (ML) sway was calculated from center of pressure data. The severely head-injured group (group 4) generally demonstrated greater AP sway than the other three experimental groups for all but one test condition. It was concluded that closed-head injury, particularly when associated with relatively long periods of unconsciousness, results in postural instability. In other words, in all conditions where one or more sensory modalities were confused or eliminated, the severely head-injured subjects performed more poorly. This suggests that residual deficits are present, even after rehabilitation. These deficits may lead to a higher incidence of orthopaedic or other type of injury.

### **A Comparison of the Anterior Drawer, Lachman and Alternate Lachman ACL Tests as Measured by the KT-1000**

Draper DO, Schulthies S, Fellingham GW. Brigham Young University, Provo, UT 84602

There are several manual tests that are used to determine the integrity of the anterior cruciate ligament (ACL). Probably the most popular are the anterior drawer and the Lachman tests. Many claim that the Lachman is the superior test, yet it is difficult to perform on a large person, especially by an examiner with small hands. One procedure, the alternate Lachman test, has been used with some success by ex-

aminers who have trouble performing the Lachman. The purpose of this study was to compare these three manual tests with respect to predicting ACL stability. These findings were compared with those of the KT-1000 knee arthrometer. Seventy-four subjects (mean age 22) volunteered for the study. All of the subjects were athletes. Girth measurements were recorded for each subject at 3 inches above and below the midpatella. The examiner performed each of the three tests on both knees of the subjects and then recorded which knee he felt was the more lax of the two, with respect to each test. Another examiner then tested each subject's knees with the KT-1000. With the data generated from the KT-1000, each subject was placed into one of three categories based upon the actual laxity difference between the two knees. Categories were: 1) subjects with .5 mm displacement difference; 2) those with <.5 to 2.5 mm displacement difference, and 3) those with >2.5 mm difference. A log-linear model with terms for manual test type, category, and thigh girth was used for statistical analysis. The alternate Lachman significantly outperformed the other two tests. For >2.5 mm difference, the Lachman test was impacted negatively by increased thigh girth. Based upon these results, the alternate Lachman should be included in the regimen of manual ACL tests, especially for athletes with large thigh circumference, or when performed by examiners with small hands.

### **The Effect of Cooling on Proprioception of the Knee**

Thieme HA, Ingersoll CD, Knight KL, Ozmun JC. Sports Injury Research Laboratory, Indiana State University, Terre Haute, IN 47809

Many athletes are treated with cold applications prior to therapeutic exercise, but the effects of these treatments on proprioception of the knee are unknown. In this study we examined the effects of a 20-minute ice application to the knee on proprioception, specifically movement reproduction. We tested knee proprioception of 37 volunteer subjects under two treatment conditions: 20-minute ice application and control. Two ice bags were applied to

surround the knee. Blindfolded subjects were asked to actively reproduce a pattern of movement on the Kin-Com dynamometer after it was performed passively on them. Differences in movement reproduction accuracy and timing were recorded in three sectors: 90° to 120°, 120° to 150°, and 150° to full extension. Air splints were applied to the leg to eliminate tactile information from the Kin-Com leg pad. Four dependent variables were measured: final angle difference, peak angle difference, time to peak angle difference, and total time of repetition difference. Data were analyzed using a MANOVA with repeated measures. Univariate F-tests and the Newman-Keuls test were used for post hoc comparisons. Cooling had no effect on movement reproduction, but there were differences between movement sectors for final angle difference and total time of repetition difference. Final angles were underestimated in the 90° to 120° sector and overestimated in the other two sectors. We think sector differences were due to the type of receptor used. Cold applications can be used prior to therapeutic exercise programs, ie, cryokinetics, without interfering with normal knee proprioception.

### **Selective Activation of Specific Quadriceps Muscles With Changes in Knee and Foot Position**

Kacsik DA, Signorile JF, Lowensteyn I, Digel SL. Human Performance Lab, University of Miami, Coral Gables, FL 33124

The purpose of this study was to determine the feasibility of using variations in foot and knee position to target the specific muscles of the quadriceps during isometric strengthening exercises. Since imbalances in these muscles can lead to future complications following rehabilitation, it would be a great benefit to the physical therapist or athletic trainer to be able to selectively target these muscles to ensure proper balance. Twenty-three healthy subjects (5 male, 18 female) performed maximal isometric contractions on a BIODEX multijoint dynamometer at three different knee

angles, 90°, 150°, and 175°; and three foot positions, inverted (I), neutral (N), and everted (E). Bipolar surface EMG was used to assess the electrical activity (rmsEMG) of the vastus medialis oblique (VMO), rectus femoris (RF), and the vastus lateralis (VL). Silver-silver chloride electrodes (15 mm) were placed 2 cm apart on the bellies of the VMO and VL and just below the visible bifurcation of the pennate of the RF. Data were collected during each 3-second isometric contraction at a collection speed of 1024 cycles/s after amplification at a gain of 2000 using separate Grass P511 differential AC amplifiers for each muscle. Data were analyzed using separate repeated measures ANOVAs with Tukey post hoc comparisons when necessary. Results showed that the RF produced the highest rmsEMG at 90° regardless of foot position. The highest rmsEMG for the VMO was at 90° with a neutral foot position ( $p < .05$ ). No significant differences in activity were found for the VL among knee angles; however, the greatest rmsEMG was noted in the neutral foot position for 90° and 150° and in the inverted foot position at 175°. Since quadriceps setting (approximately 180°) is used commonly during the initial stage of knee rehabilitation, it is of great interest that the highest rmsEMG for all muscles at 175° was seen with the foot in the inverted position ( $p < .05$ ). These data indicate that the best position for rehabilitation of all quadriceps muscles is 90° with a neutral foot position. However, during the early stages, when quadriceps setting is the exercise of preference, an inverted foot position should be used to elicit a balanced response from all of the muscles involved.

**Session #5—Friday, June 11  
Clinical Studies—Isokinetics:  
3:00-4:30 pm**

### **The Effect of Audio and Visual Feedback on Concentric and Eccentric Isokinetic Torque Values of the Quadriceps**

Steckley PL, Dolan MG, Reeds GK, Bibi KW. The Human Performance

Laboratory, Canisius College, Buffalo, NY 14208

The purpose of this study was to determine the effect of audio and visual feedback on concentric and eccentric average and peak torque values on the quadriceps. Sixty college students, 43 males and 17 females (age=20.3±1.6 yr; height=173.5±7.6cm; weight=77.3±14.6 kg), volunteered for this study. An orientation session was conducted one week prior to testing to acquaint the subjects with the testing device. Fifteen subjects were assigned randomly to each treatment group: auditory (A), visual (V), audiovisual (AV), and a control group (C), where no feedback was provided. Prior to the isokinetic testing, each subject engaged in a 5-minute warm-up session, using a cycle ergometer, followed by a 3-minute static quadriceps and hamstring stretching. Three gradient submaximal warm-up contractions were performed prior to testing. Immediately thereafter, each subject was tested at an angular velocity of 60°/s for concentric average torque (CAT), concentric peak torque (CPT), eccentric average torque (EAT), and eccentric peak torque (EPT) using the Kin-Com dynamometer. Three maximal concentric and eccentric contractions followed, while the subjects received the designated form of feedback. The auditory feedback consisted of a verbal command of "PUSH" for the concentric phase, and "HOLD" for the eccentric phase. Visual feedback consisted of viewing the torque output curves displayed on the computer monitor. The audiovisual feedback consisted of both simultaneously. The control group received no form of feedback. Feedback response data were analyzed separately by means of independent one-way analysis of variance (ANOVA), with a significance level of 0.05 selected. The analyses yielded no significant differences between the four treatment groups for CAT, CPT, EAT, and EPT. (See Table 1.) Our data suggests that feed-back, in the form of auditory, visual, or a combination of both, does not significantly affect isokinetic performance.

## Comparison of Isokinetic Hip Abduction and Adduction Strength in Apparently Healthy Women

Harter RA, Robinson TL, Gillis DE, Snow-Harter CM. Oregon State University, Corvallis, OR 97331

Few cross-sectional studies of isokinetic hip abductor and adductor strength in normal female subjects have been conducted. We measured hip abduction (AB) and adduction (AD) strength in 97 apparently healthy women (mean age, 36.7 yrs; range, 17 to 82 yrs) using a Kin-Com 500 H dynamometer. Subjects were assigned to four groups based upon their activity level and age: NCAA Division I intercollegiate athletes (n=33), university students (n=19), middle aged (n=24), and elderly (n=21). From a side-lying position, subjects performed five maximum voluntary concentric movements of both hip abduction and hip adduction at 30°/s. Intraclass reliability estimates for this experimental protocol were .972 for hip abduction and .965 for hip adduction peak force values. Body fat percentage (BF%) was determined by Hologic QDR 1000/W dual energy x-ray absorptiometry. Dependent

measures included BF%, gravity-corrected AB and AD peak force, angle of peak force, and normalized AB and AD peak force values (N/kg body weight [BW] and N/kg lean body weight). Results of ANOVAs revealed significant differences ( $p < .001$ ) among groups for all dependent variables except AD/AB peak force ratio ( $p > .18$ ). Our results provide clinicians with cross-sectional, normative values when evaluating hip AB/AD strength among women with a Kin-Com isokinetic dynamometer. (See Table 2.)

## The Reliability of Four Different Methods of Calculating Quadriceps Peak Torque

Arnold BL, Perrin DH. University of Virginia, Charlottesville, VA 22903

This study determined the reliability of four different methods of calculating peak torque with the Kin-Com (Chattecx, Hixson, Tenn) isokinetic dynamometer. Twelve university female students (age=21.8±2.3 yr, wt=56.8±12.9 kg, ht=166.6±5.4 cm) gave informed consent to participate in the study. In each of two different test sessions, subjects first warmed up on a

stationary bicycle for 5 minutes and then were placed on the Kin-Com with the axis of the dynamometer aligned with the medial epicondyle of the femur. Velcro straps were placed proximal to the malleoli and knee and across the hips for stabilization. The vertical and horizontal positions of the dynamometer were measured to ensure identical placement on the second test. Subjects executed three submaximal followed by one maximal concentric and eccentric muscle contraction at 60°/s. After a 2-minute rest, subjects executed five maximal concentric and eccentric contractions. For data analysis, the first three torque curves of each set of five contractions were averaged together, and the highest value was identified as peak torque. Additionally, each of the three curves was examined separately, and the single highest value was identified as peak torque. The same procedure then was followed for all five curves. Intraclass correlation coefficients (ICC) for the four peak torque values for concentric and eccentric contractions were calculated. The ICCs and the standard error of measurement (SEM) for the mean of 3 curves, the mean of 5 curves, the best of 3 curves, and the best of 5 curves were .92(10.02), .95(7.45), .92(9.7), .96(7.10) and were .96(9.98), .97(8.72), .95(11.87), .96(10.55) for concentric and eccentric data, respectively. These data suggest very good reliability using any of the four techniques of calculating peak torque. The highest coefficients (with lowest SEM) were the best value of five torque curves for concentric peak torque and the mean value of five torque curves for eccentric peak torque.

**Table 1.—Torque Production (Nm±SD)—Steckley et al.**

Independent Variable	Auditory (n=15)	Visual (n=15)	Audiovisual (n=15)	Control (n=15)	P Value
CAT	108.93±31.06	121.53±31.85	118.07±24.25	110.00±27.91	0.569
CPT	190.00±61.40	192.00±60.15	188.53±42.96	179.27±52.32	0.923
EAT	146.47±46.57	146.93±41.58	159.47±35.08	133.80±35.98	0.388
EPT	221.13±77.62	209.73±59.30	244.20±65.94	193.80±46.12	0.181

**Table 2.—Summary of Hip Strength Values—Harter, et al.**

Group	N	Mean Age(yrs)	Body Fat %	Abduction Peak Force	Adduction Peak Force	AB Peak F (N/kg BW)	AD Peak F (N/kg BW)
College Athletes	33	20.9±2.1	15.1±2.4	362±84N	321±73N	6.7±1.1	6.0±1.1
College Students	19	19.1±1.6	22.3±3.0	348±97	271±80	5.8±1.4	4.5±1.2
Middle Aged	24	40.7±4.8	26.0±4.3	310±53	248±67	4.9±0.8	3.9±1.2
Elderly	21	72.2±5.2	29.2±5.4	223±54	178±60	3.6±0.8	2.8±0.9

### The Effect of Test Speed Sequence on the Concentric Isokinetic Performance of the Knee Extensor Muscle Group

Fyke D, Timm KE. St. Luke's Sports Medicine, Saginaw, MI 48602

The purpose of this study was to investigate the effects of different sequences of concentric isokinetic test speeds on knee extensor muscle peak torque production and also to attempt to validate the findings of previous studies that have suggested that slow test speeds should precede fast test speeds in an isokinetic clinical testing program. Under a sequential repeated measures design, which included a test-multiple retest paradigm, 72 subjects (39 males, 33 females; ages 17-28 yrs) were assigned randomly to one of six groups for the testing of a randomly selected knee on a Cybex 340 dynamometer system. Each test group was subjected to a different order of slow (60°/s), intermediate (180°/s), and fast (300°/s) speeds in a sequential manner. Testing occurred on six different sessions, each session separated by 48 hours, for each group and consisted of a standardized cardiovascular and isokinetic warm-up followed by peak torque data collection across five maximal efforts at each speed. Multifactorial ANOVA revealed significant differences ( $p < .001$ ) between speeds, but not between sessions or the combined factors of speeds and sessions across the experiment. A post hoc Scheffé test confirmed the differences between speeds. ICC tests revealed a high level of reliability (0.81) across both test speeds and sessions. It was concluded that isokinetic test speed order did not affect concentric peak torque measurements, that distinct differences existed between the individual test speeds, and that the procedures afforded a high degree of muscle performance measurement consistency. The results of this study are important for the design of clinical test protocols for the knee extensor muscle groups that incorporate isokinetic technology. This is the first study to find that the specific sequence of concentric isokinetic test speeds does not affect actual peak torque performance results.

### Mechanical and Clinical Reliability of the Kinetic Communicator's Gravity Correction Procedure

Hellwig EV, Perrin DH. University of Virginia, Charlottesville, VA 22903

Gravity correction is an accepted practice when assessing isokinetic muscle performance. This study examined the mechanical and clinical reliability of the Kinetic Communicator (Chattecx, Hixson, Tenn) gravity correction procedure. To determine mechanical reliability, gravity correction was performed for 15 consecutive days at 11 different angles (15° increments from 75° above horizontal to 75° below horizontal) under four weight conditions (1.15, 2.3, 3.45, and 4.6 kg). Intraclass correlations (ICCs) between trials showed the Kin-Com was able to gravity correct weights with high reliability ( $R = .961$  to  $.999$ ). Gravity correction values collected near the vertical position differed from the gravity correction values collected at the horizontal position ( $p < .05$ ). To determine clinical reliability, the lower extremities of 25 subjects (age=21.0 yrs, ht=166.6 cm, wt=59.8 kg) were gravity-corrected in both the seated and prone positions at six different angles (0°, 15°, 30°, 45°, 60°, and 75°) on 2 separate days. Correlational analysis between days showed good reliability ( $R = .83$ ) for both positions when subjects were corrected at horizontal. Reliability decreased as the lever arm approached vertical ( $R = .45$ ). The gravity correction procedure as performed on the Kin-Com is both mechanically and clinically reliable. However, for optimal clinical reliability, subjects should be corrected with the limb/lever arm near horizontal.

### The Effect of Range of Motion and Preload on Isokinetic Average and Peak Torque of the Knee Musculature

Tis LL, Perrin DH. University of Virginia, Charlottesville, VA 22903

Isokinetic dynamometers require clinician specification of several assessment parameters, including range of motion (ROM) and preload (PL). Currently, a variety of preloads and ranges of motion have been used clinically. However, little research has reported the effects of these variables on torque production. Therefore, the purpose of this study was to examine the effect of two ROM and PL settings on torque (Nm) production of the knee musculature. Twenty females (age=20.2±1.0 yr; ht=169±6.8 cm; wt=60.8±5.5 kg) were assessed randomly for isokinetic (Kin-Com, Chattecx Corp, Hixson, Tenn) concentric (CON) and eccentric (ECC) average and peak torque of the knee extensor (EXT) and flexor (FLEX) musculature at a velocity of 90°/s. Two ROM (5 to 90° and 25 to 70°) and two preload settings (0N and 75N) were used. A 4-way ANOVA (muscle X mode X ROM X PL) revealed significant differences in average torque between the ROM and PL settings for CON and ECC EXT and FLEX ( $p < .05$ ). (See Table 3.) A second 4-way ANOVA for peak torque values revealed no differences between the conditions. Based on the findings of this study, ROM and PL should remain constant between and among subjects if average torque is used as the criterion measure. If this is not possible, peak torque should be employed as the criterion measure.

Table 3.—Range of Motion & Preload Effects—Tis and Perrin.

	5-90 ROM;0N	5-90 ROM;75N	25-70 ROM;0N	25-70 ROM;75N
EXT CON	68.3±17.2	74.3±17.2	71.5±20.8	79.0±13.0
EXT ECC	82.8±27.8	85.6±28.6	93.6±26.5	97.7±23.4
FLEX CON	43.1±5.6	43.5± 9.2	41.2± 8.9	44.2± 8.9
FLEX ECC	55.6±17.8	56.7±16.3	51.8±14.0	57.3±14.0

### Identification of Eating Disordered Behavior in College-aged Female Athletes

Moul JL, Warren BJ, Blessing DL\*.  
Appalachian State University, Boone,  
NC 28608 and \*Auburn University,  
Auburn, AL 36830

The purpose of this study was to determine physiological/psychological parameters which differentiate a group of college-aged female athletes identified as at risk for an eating disorder (Group R=29) from those who were not identified as at risk (Group N=52). Subjects were 30 college-aged controls (nonathletes) and 51 NCAA IA female athletes in six sports (basketball, cross country, golf, gymnastics, swimming, volleyball). The Eating Disorder Inventory (EDI) was administered to classify subjects who were at risk of developing an eating disorder ( $EDI \geq 40$ ). All subjects had height, weight, and body composition (7-site skinfold) assessed. In addition, the following inventories were administered: Eating Attitudes Test (EAT), Reproductive Health Survey, a 3-day dietary record, and a 30-minute standardized individual interview. The student's t-test analysis revealed no group differences for height, weight, % body fat, or total kcal intake. Significant differences ( $p \leq .05$ ) were found for EAT ( $R=25.6$  vs  $N=11.0$ ), kcal/kg ( $R=25.7$  vs  $N=34.8$  kcal), and EDI subsets of Drive for Thinness, Bulimia, Interoceptive Awareness, and Maturity Fears. In addition, interview results indicated significant differences ( $p \leq .05$ ) in current vs desired weight ( $R=13.8$  vs  $N=5.4$  lbs), as well as Likert scale differences in weight perception, dieting behavior, and fear of becoming fat. In summary, assessment of body weight, % body fat, and total kcal intake did not differentiate between groups. Instead, a composite data profile appears warranted to identify athletes who may be at risk for an eating disorder.

### Factors of Satisfaction for College Student Athletic Trainers

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University, Raleigh, NC 27695

The purpose of this study was to discover the factors that affect satisfaction of college student athletic trainers during their clinical hours. Because the goal of clinical education is to provide learning in a job-like setting, for this investigation, elements of job satisfaction research and clinical education are combined. The data were collected through the administration of a survey of student athletic trainers in one randomly selected athletic training program in each of the 10 NATA-delineated districts across the United States. The respondents were asked to assess the various factors of satisfaction, using the Job Descriptive Index. The JDI is a standardized survey that has been used since its development in the 1960s to measure job satisfaction in many occupations, including several studies in allied health professions. Those factors in question are job in general, athletics, opportunities for promotion, supervision, and work. There were also questions concerning demographic characteristics such as grade point average (GPA), level in school, and gender. A total of 171 surveys were returned from 9 of the 10 schools surveyed for a 63% response rate. The work and supervision variables were significant for the group as a whole. However, when broken down by gender, the females found the work and opportunities for promotion and supervision as significant, but the males only found the work as significant. The group was broken down into seniors and underclassmen as well. The seniors felt that the work and supervision were significant, while the underclassmen felt that the work was the only significant factor. The results indicate the importance of the intrinsic rewards associated with one's job or clinical education and seem to stress the importance of productive use of time spent in the training room. The concept of job enrichment could be implemented in order to provide the students with more autonomy, variety, and responsibility to

increase their satisfaction with the work that they do.

### Status of Sports Health Care for High School Athletes in Hawaii

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University of Hawaii at Manoa, Hono-  
lulu, HI 96822

In 1991, Hawaii High School Athletic Association estimated that more than 21,000 student-athletes were participating actively in organized athletics within the state's 61 (38 public and 23 private) high schools. In order to determine the current practices of sports health care for the high school athletes in the state, a 30-question survey was constructed and mailed to the athletic directors of all 61 schools. The questions were designed to gather information concerning numbers of participants, coaches, practices of sports health care, qualifications of sports health care providers, emergency policies and procedures, and interest in improving the current status of sports health care. Specific questions included: 1) what type of medical supervision is being provided at organized practices, 2) who serves as the school athletic trainer, 3) who provides immediate care for injured athletes, 4) who provides for prevention, care, and rehabilitation for injured athletes, 5) who provides follow-up evaluation for injured athletes, 6) who determines return to participation following injuries, and 7) what type of training do the sports health care providers have. The overall response rate was 100% (61/61). The data were assessed descriptively and a chi-square analysis was performed to examine distribution of frequencies between the public and private schools. The results indicated that 8% (5/61) of the schools (all private) employed certified athletic trainers, 28% (17/61) had noncertified athletic trainers, and 64% (39/61) had coaches serving as the school athletic trainer. Twenty-nine percent (16/56) of the designated athletic trainers (noncertified and coaches) had no training, 27% (15/56) had participated in a coaching education class, and 44% (25/56) had first aid and CPR certification. Eighty-

nine percent (50/56) of the schools without certified athletic trainers indicated that they would hire a certified athletic trainer if funds were available. Lastly, significant differences ( $p < .05$ ) were observed between the public and private schools for practices of sports health care. These findings indicate that the sports health care for injured student-athletes at the high school level in the State of Hawaii needs to be improved.

### **Patterns of Over-the-counter (OTC) Nonsteroidal Anti-inflammatory Drug (NSAID) Use by College Baseball Pitchers**

Cramer CR. Barry University, Miami Shores, FL 33161

Three veteran college pitchers at each of the 711 NCAA-sponsored institutions were contacted by questionnaire regarding their use of OTC NSAIDs during the fall of 1992. The 24% response to this survey represented 521 respondents. Results were based upon responses to the 10 questions asked on the questionnaire. Affirmative responses were given by 79% of the respondents when asked if they had ever used an OTC NSAID before. The remaining questions were asked only of that 79%. Current OTC NSAID use was reported by 37%. Several (42%) reported no current use since they were not in season. Respondents disclosed a mean of 5.91 as the maximum number of 200 mg tablets taken in a 24-hour period, with a mean of 3.01 tablets taken as a maximum in a single dose. The mean duration respondents maintained dosage on OTC NSAIDs was 4.63 weeks. A mean of 3.37 was reported as an average dose taken with a mean of 4.37 the average tablets per day. A minority 29% of respondents perceived a mean of 986.84 as the maximum OTC dose per day in milligrams with over 70% responding that they did not know the maximum dose. An even smaller group (5.8%) responded that they perceived the toxic overdose levels at a mean 2170.8 mg with the remaining

94.2% responding that they did not know the toxic level. A group comprising 96.6% of the respondents reported that they had never used an excess of 3200 mg in one day during their careers, with the remaining 3.4% indicating that they had maintained a dose in excess of 3200 mg for a mean of 1.8 weeks. The responses represent an apparent need to bridge the gap on information regarding OTC NSAIDs and their use in order to better educate those players using these drugs.

**Session #7: Saturday, June 12  
Case Reports: 10:00-11:40 am**

### **Lower Extremity Pain in a Basketball Player**

Preston DW, Stone DA. University of Pittsburgh Medical Center, Pittsburgh, PA 15260

While attempting a jump shot, a 17-year old white female basketball player heard a pop accompanied by sudden pain in the posterior part of her right ankle. Her ankle initially was treated with ice, compression, and crutches by the athletic trainer. The next day, the patient was examined by the team physician, who found that she had a tender posterior talus and was unable to do a calf raise. Findings of a Thompson's test were negative.

### **Persistent Headache in a High School Football Player**

Litt DW, Mason CW. SportsMedicine Grant, Columbus, OH 43215

This study reviews the case of a 16-year-old Caucasian football player who developed a headache following a collision on the last play of a game. His headache persisted for 1 week, at which time he underwent a computerized tomographic (CT) scan to determine the cause of the headache. The CT scan was read as normal and the athlete was placed on Elavil 5 mg po at hs for his headache. A diagnosis of concussion was made by the team physician. Ten days after the CT scan, the athlete reported a disappearance of his symptoms. Evocative testing failed to recreate symptoms, and the athlete was

allowed limited participation 3 weeks after the initial injury. The athlete continued to deny any symptoms and was cleared for unlimited participation 30 days after the initial injury. In the next game, the athlete received a blow to the head and exhibited a lucid interval before deteriorating on the sidelines. The athlete was rated at 5 on the Glasgow Coma Scale (GCS) by team physician before being intubated by local EMS personnel and transported to the emergency room of a local hospital.

### **Hip Pain in a Collegiate Runner**

Draper DO, Dustman AJ. Illinois State University and McLean Co Orthopaedics, Normal, IL 61761

A 20-year-old male distance runner was participating in an interval training workout consisting of repeat quarter-mile strides around the perimeter of a park. As he attempted to make a left turn around a tree, he felt a snap in his left hip and fell to the ground. During an examination by his athletic trainer, the athlete exhibited point tenderness and swelling over his left anterior superior iliac spine (ASIS). The athlete was not able to actively flex his hip and had a muscle grade of 1-trace for hip flexion. An ice pack with a hip spica wrap was applied to the area and the athlete was taken to the hospital for x-rays.

### **Thoracic Pain in a Collegiate Swimmer**

Wasik MP, McFarland EG. University of Florida, Gainesville, FL 32601

An 18-year-old white male collegiate varsity distance swimmer presented to the training room with complaints of left, posterior chest pain after several difficult workouts. There was no history of trauma. He had no shortness of breath, but the pain was present during deep inspiration and during the follow-through of the freestyle stroke. The pain was nonradiating and did not wake him from sleep. He had no fevers or other illnesses. The pain was not relieved with anti-inflammatories. The possible differential diagnoses were: intercostal muscle strain,

pleural process, snapping scapula, or stress fracture. The physical exam showed the patient in no distress, and vital signs were normal (R 14, BP 120/70, P 54, T 98.4). His breath sounds were normal and his heart examination revealed no abnormalities. His neurological exam revealed normal strength in all muscles with no winging of his scapula. There was no scapular crepitus. He was tender 3 to 4 centimeters lateral to the midline of the T8-9 level. Tests included a chest x-ray, which revealed normal heart and lungs. Scapular views and thoracic spine x-rays revealed no abnormalities.

**Session #8: Saturday, June 12**  
**Case Reports: 1:00-2:40 pm**

### **Knee Pain in a Recreational Athlete**

Ireland ML, Chang JL, Williams P. Kentucky Sports Medicine, Lexington, KY

A 47-year-old white male injured his left knee demonstrating basketball skills while driving toward the basket. He had no previous history of knee problems. He was an avid tennis player. He complained of immediate pain and pop and swelling and inability to straighten his left knee. On physical exam, pertinent positive findings were a tense effusion with severe tenderness to palpation along the superior patella. Active range of motion was 15° to 90°. He exhibited negative apprehension sign on lateral patellar subluxation maneuvers.

### **Foot Pain in a Collegiate Gymnast**

Carter LD, Cronk R. Oregon State University, Corvallis, OR 97331

A 20-year-old female Caucasian gymnast sustained a fracture-dislocation of her right ankle while performing a dismount from the balance beam. Surgical repair of the ankle ligaments and stabilization of the fractured distal fibula with plate and screws restored normal anatomical alignment of the injured ankle. The athlete was placed in a long leg cast for 4 weeks and then in a

foot-ankle orthosis. Eight weeks postoperatively, the athlete dropped a 5 lb weight on her foot. She did not report the incident to her athletic trainer for 3 weeks, at which time she was referred to the team physician. The physical examination revealed slight swelling and moderate tenderness over the right second metatarsal neck. To rule out a possible metatarsal neck fracture, the team orthopedic physician ordered plain films. Radiographic evaluation showed no evidence of a fracture or dislocation in the foot. The athlete continued to have an uneventful recovery from the ankle injury, although her foot remained tender. When the athlete was seen for her 6-month postsurgical examination, plain films of the foot again were ordered due to the athlete's clinical presentation of perceptible swelling over the neck of the second metatarsal.

### **Arm Pain in a Recreational Weight Lifter**

Hutchinson MR, Ireland ML, Katz NT, Williams P. Kentucky Sports Medicine, Lexington, KY 40517

A 31-year-old right-hand dominant white male was seen for severe pain of both elbows. He had been doing preacher curls with 125 lbs on an unfamiliar bench when he felt a painful pop. On physical exam, he had ecchymosis and soft tissue swelling on the superior anterior aspect of both elbows. Neurovascular examination was within normal limits. He had pain on active flexion and supination. Test results: plain radiographs were within normal limits.

### **Calf Pain in a Collegiate Football Player**

Perrine JD, Ireland ML, Green A, Stanley S. University of Kentucky, Lexington, KY 40506

A 22-year-old white male collegiate football center developed insidious onset of multiple joint pain and swelling, including both shoulders, right elbow, right wrist, and right knee over a 4-day period. When Fall practice began, increased right knee pain and swelling occurred. He had undergone arthroscopy, partial medial meniscectomy, and

extra-articular reconstruction 4 years previously, from which he had done well. He developed calf pain, swelling, and redness. He also had a low grade elevated temperature and easy fatigability. Physical Exam: T 99. There was pain on range of motion of both shoulders and range of motion of right knee. Wrist exam showed diffusely boggy synovium, pain over medial clavicle on palpation. Right knee exam showed moderate effusion, 10° to 110° range of motion. He had severe pain on palpation of the posterior knee and increased calf girth by 2 inches. He had a positive Homan's sign with neurovascular status intact otherwise.

Laboratory Tests: CBC with differential revealed white blood count of 9,500 with 70% PMN's, 13% B, 15% L, 10 M. ESR was 54 mm/hr.

## **Poster Presentations**

**To be displayed in Convention Center Exhibit Hall: Thursday-Saturday, June 10-12, 1993.**

### **"Name Crisis" Survey for Athletic Trainers**

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

"Sports Medicine" seems to be a title frequently used to describe the athletic training profession. The purpose of this study was to survey undergraduate athletic training programs, approved by the National Athletic Trainers' Association, to determine what title they believed best described the athletic training profession. A survey was developed and sent to 33 schools representing the 10 districts of the National Athletic Trainers' Association. Twenty-four programs responded (73%), with a total of 417 completed surveys. The following table indicates which descriptors were chosen, according to rank and frequency:

<b>I. Population Descriptors</b>		<b>II. Professional Descriptors</b>	
1. Athletic	(52%)	1. Medicine	(68%)
2. Sports	(48%)	2. Injury	(32%)
	100%		100%

### III. Job Descriptors

1. Therapy/Therapist	(41%)
2. Training/Trainer	(31%)
3. Specialty/Specialist	(28%)
	100%

### IV. Combined Descriptors (2 word)

1. Sports Medicine	(28%)
2. Sports Therapist	(21%)
3. Athletic Trainer	(15%)
4. Athletic Therapist	(15%)
5. Other	(21%)
	100%

### V. Combined Descriptors (3 word)

1. Sports Medicine Therapist	(22%)
2. Sports Medicine Specialist	(15%)
3. Sports Medicine Trainer	(12%)
4. Other	(51%)
	100%

According to these results, 68% of the returned surveys preferred the professional descriptor of "medicine," job descriptor of "therapist" (41%), two-word descriptor of "sports medicine" (28%), or "sports therapist" (21%), with a combined three-word descriptor of "sports medicine therapist" (22%). "Athletic training" had a 15% response. We concluded that a "name crisis" does exist among NATA-approved program curriculum students; otherwise, "athletic training" would have been the number one choice instead of fourth. Further studies need to be completed, using certified athletic trainers representing different job sites (eg, high school, college/university, professional, clinic/industrial, and retired).

## A Regional Analysis of the Hiring Practices of Athletic Trainers by High Schools in Northern Illinois

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The primary purpose of this study was to examine the regional differences in the present and future hiring practices of athletic trainers by high schools in northern Illinois. A survey was sent to the athletic directors of 426 public and private high schools in 20 northern Illinois counties. The results of the survey were cross-tabulated regionally and examined by a frequency analysis. Northern Illinois was partitioned into four regions: Chicago (n=96), Rockford

(n=7), a suburban area (n=57), and a rural area (n=69). The results of the study revealed that 23% of the high schools employ an athletic trainer with teaching responsibilities. Of this 23%, most of the high schools in the suburbs (54%) and Chicago (40%) hire a full-time teacher with a stipend to provide athletic training services. The majority of rural high schools (50%) hire a full-time individual with a contract to teach, coach, and provide athletic training services. However, the schools in Rockford do not hire a teacher/athletic trainer. The majority of schools (64%) that employ a teacher/athletic trainer reported that physical education was the teaching assignment. Forty-nine percent of all schools hire an athletic trainer from a sports medicine clinic. When the relative distribution was examined regionally, Rockford employed more clinical athletic trainers (71%), followed by the suburbs (53%), Chicago (49%), and, lastly, the rural area (43%). If funds were available, most of the athletic directors (47%) would prefer to hire a teacher/athletic trainer. Thirteen percent of the schools intend to hire an athletic trainer in the next 2 years. Of this 13%, Chicago plans to employ the most (46%), followed by rural region (37%), the suburbs (13%), and, lastly, Rockford (3%). Half of these schools will hire an individual with an assignment to teach, and 68% of the athletic directors report that the teaching assignment will be in physical education. Currently, with the exception of Rockford, high schools employ either a full-time, part-time, clinical, or teacher/athletic trainer. However, in the next 2 years, half of the job openings in athletic training will require a teaching assignment.

## Determining Specific Sites of Foot Discomfort During Ice Bath Immersion

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The purpose of this information is to give clinicians descriptive information regarding the discomfort an athlete can experience during a therapeutic ice immersion. We received informed consent

from 28 volunteers (13 males, 15 females, age=21.2±4.0 yr, ht=68.3±4.0 in, wt=152.1±32.6 lb) from the general student body of the University of Nevada, Las Vegas. Subjects were excluded from the study if they were hypersensitive to cold, had known peripheral vascular disease, or had impaired sensation of the lower extremities. Subjects were free to withdraw from the experiment at any time without prejudice. A version, slightly modified, of the McGill Pain Questionnaire (MPQ) with pictures of the dorsal, plantar, medial, and lateral aspects of the foot was added to the form so that the subjects could shade in the areas on the foot where pain was perceived most highly during the experimental session. The subjects were brought into the experiment room each day at approximately the same time. On the first day, the experimenter explained the process and the MPQ form, and all subjects were given time to familiarize themselves with the form. The experimenter then began the experiment by having all subjects place their right feet and ankles into the ice bath (water temperature 2°C/1°C) for 21 minutes. No attempt was made to control the water temperature during the immersion process so that we would simulate a clinical protocol. Thirty seconds after immersion, the subjects were asked to complete the MPQ, indicating their perceptions of pain, and to shade the areas on the figures of the foot to indicate the site of the discomfort. Subjects then were asked to complete the form after 3 minutes, 6 minutes, and every 3 minutes thereafter until 21 minutes. At that point, the subjects were told to remove their feet from the water and set them on towels next to the ice bath. The subjects were reminded to complete the form every 3 minutes for another 21 minutes. Each subject completed the protocol for 5 days. The data was compiled to describe the place on the foot that produced discomfort for each subject over the 5-day period. The results indicated the subjects described more discomfort in the toes after taking their feet out of the ice bath on day 5 than putting their feet in the first day. There also tended to be more discomfort as the days progressed, especially in the toes.

There was discomfort in other parts of the foot, but not as great as the top and bottom of the toes. This indicates to us that further research of this type using toe caps will be beneficial in determining if ice immersion therapy can be more tolerable.

### **Effect of Cold and Compression on Swelling Following ACL Reconstruction**

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The purpose of this study was to determine the effects of cold and compression on postoperative swelling following ACL reconstruction. Forty-four patients undergoing ACL reconstruction were assigned randomly to an experimental or control group. Cold and compression were applied continuously for the first 7 days post-op to the experimental group by use of the Aircast Cryocuff (n=23). The control group used ice packs ad lib (n=21). Otherwise, the postoperative management between the two groups did not differ. Swelling was assessed prospectively on postoperative days 2, 7, 14, 28, 42, 56, and 84 as the side-to-side difference in midpatellar girth. Differences in midpatellar girth over time were examined, using a repeated measures analysis of variance. Additionally, the volume of intra-articular swelling was calculated, using MRI three-dimensional imaging on postoperative day 7 in 16 patients who were matched for type of graft and use of a postoperative hemovac drain. A matched pairs Wilcoxon test was used to analyze the volume of intra-articular swelling. The two groups did not differ in terms of age, sex, graft type, or associated surgical procedures. There was a significant linear downward trend in side-to-side difference of midpatellar girth over time, indicating resolution of swelling; however, there was no difference in this downward trend between groups. The matched pairs Wilcoxon test indicated that the difference within matched pairs was not significant (p=.624). The results failed to

demonstrate that cold and compression were more effective than ice packs applied ad lib in reducing swelling following ACL reconstruction.

### **A Measure of Superficial Tissue Temperature During 1 MHz Ultrasound Treatments Delivered at Three Different Intensity Settings**

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During the past few years, there have been some *in vivo* studies showing that ultrasound effectively causes a tissue temperature rise (TTR) in the deep tissues. Whether or not ultrasound causes the same TTR in superficial tissues has remained unanswered. The purpose of this study was to discover the effect that 1 MHz ultrasound had on TTR in the superficial tissues (1 cm depth) delivered at varying intensities. Twenty-one males (mean age 22) participated in this study. Seven subjects were placed into one of three groups: 1) those to receive ultrasound at .5 watts/cm<sup>2</sup>; 2) those to receive ultrasound at 1.0 watts/cm<sup>2</sup>, and 3) those receiving ultrasound at 1.5 watts/cm<sup>2</sup>. A 23-gauge thermistor needle was inserted 1 cm deep into the anesthetized medial gastrocnemius muscle of the subjects. The thermistor was connected to a monitor that measured deviations in temperature to the nearest .1°C every 30 seconds. Fifteen ml of 37°C ultrasound gel was applied to a 10 cm-in<sup>2</sup> diameter treatment area. Continuous ultrasound with an overlapping technique was delivered to each subject for 10 minutes at the appropriate setting. The mean baseline temperature was 35.4°C. The mean temperature increase at .5 watts/cm<sup>2</sup> was .6°C. The mean temperature increase at 1.0 watts/cm<sup>2</sup> was 2.3°C, and at 1.5 watts/cm<sup>2</sup>, the temperature increased 2.7°C. This resulted in a significant difference (p.05) in TTR at the three different intensities. We can see from this that as the intensity increases, so does the temperature. However, at the highest intensity tested, the mean TTR was only 2.7°C. A year ago, fol-

lowing these same methods, Draper and Sunderland found a 4.3°C increase in tissue temperature at 3 cm depth using an intensity of 1.5 watts/cm<sup>2</sup>. When these two studies are compared, it can be seen that 1 MHz ultrasound heats deep tissues better than superficial ones. We believe the reasons for this might be due to: 1) reflection of the sound off the bone, thereby heating the deep tissues closest to the bone; and/or 2) attenuation of the ultrasound beam. Most ultrasound energy delivered at 1 MHz is absorbed by tissues 3 to 5 cm deep, whereas most of the ultrasound beam delivered at 3 MHz is absorbed at 1 cm depth, thereby heating the superficial tissues. Therefore, when heating of superficial tissues is desired, we suggest the use of 3 MHz ultrasound, instead of the most frequently used 1 MHz units.

### **A Biomechanical Comparison of Ankle Support Devices During Plantarflexion, Inversion Stress**

Jenike M, Kimura I. Temple University, Philadelphia, PA 19122

The purpose of this study was to compare the ability of the Aircast Sport Stirrup, the Swede-O Universal Ankle Brace, the Pro Super-8 Ankle Brace, and the non-supported ankle (control) to prevent subtalar joint motion (STJ) during an application of controlled stress. Stress was applied by a platform that dropped the ankle into 35° of inversion and 20° of plantarflexion. Testing was performed on 18 uninjured, pain-free subjects. Each participant was given one practice session to become familiar with the action of the stress platform and the procedure of the study. All subjects were prepared for filming by bilaterally marking the posterior knee joint line, the Achilles tendon at the level of the STJ, and the distal calcaneus. Randomized trials were filmed at 100 frames per second with a high speed motion camera to provide data for analysis of total angular displacement at the STJ during each test. A digitizer and computer were used to transpose the joint markings on the film to angular data. Angular data were smoothed with a cubic spline program of the International and Statistical Libraries (IMSL),

1986. Smoothed angular displacement data were analyzed using an analysis of variance with repeated measures to determine the effect of each test condition. The F value that was calculated showed a significant difference at the  $p < .01$  level for the test conditions. A Newman-Keuls post hoc test revealed a difference between each brace and the control, but failed to show a significant difference among the braces themselves. Results indicated that subjects had significantly less angular displacement of the STJ when wearing the Aircast Sport Stirrup, the Swede-O Universal Ankle Brace, or the Pro Super-8 Brace than when not wearing any support. Although the results failed to show a significant difference in the level of support between braces, the Aircast Sport Stirrup ( $28.4 \pm 36.81$ ) indicated the smallest mean angular displacement at the STJ followed by the Swede-O Universal Ankle Brace ( $29.2 \pm 87.03$ ) and the Pro Super-8 Ankle Brace ( $29.6 \pm 17.85$ ). The lack of statistical significance among the braces tested makes choosing a brace difficult. Personal choice may stem from comfort, costs, or need since each brace provides control of inversion movement.

### **Effects of Sport-stirrup and Taping on Ankle Inversion Before and After Exercise**

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The purpose of this study was to compare the effectiveness of the Sport-stirrup and taping in restricting ankle inversion range of motion (ROM) before and after exercise. Thirty males ( $22.6 \pm 3.4$  yr) with no recent history of ankle injury were assigned randomly to one of the following groups: Sport-stirrup, taping (closed basket weave), and control. Passive ankle inversion was measured without shoe wear with a blinded goniometer under three testing conditions: prior to the application of an external support system, following the application of an external support system, and after exercise. Exercise consisted of a 20-minute, full court basketball game. A repeated measures ANOVA, along with a Tukey's post hoc

procedure, revealed no significant differences among the Sport-stirrup, tape, and control groups. However, there were significant differences between presupport, postsupport, and postexercise ROM, as well as a significant interaction among group and treatment conditions ( $p < .05$ ). There was a significant decrease in ankle inversion in the tape group following application, but this restriction was not maintained following exercise. The Sport-stirrup provided a statistically significant decrease in ankle inversion upon application, but this decrease of  $3^\circ$  was not clinically significant. In addition, there was no significant difference between presupport and postexercise ankle inversion means. These results tend to suggest that the Sport-stirrup may not be effective in limiting ankle inversion without proper footwear.

### **HSS Functional Knee Test Score**

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Following a knee injury, the assessment of an athlete's ability to safely return to sport is essential. Historically, following a course of rehabilitation, subjective complaints (eg, pain and apprehension, range of motion measurement, and isokinetic measurements of quadriceps and hamstring muscle deficits) have been the standard for determining this assessment. These parameters have their merits and are included in the final evaluation of the athlete. To better evaluate knee function, we suggest that a battery of objective tests be performed to measure power, endurance, agility, and neuromuscular coordination. A lower extremity functional test has been developed at our institution that assesses these parameters. These tests are performed under controlled clinical conditions and simulate sport-specific conditions by using a closed kinetic chain environment. The tests described are simple to perform and grade, require minimal space, and can be adapted to most clinical settings. An isokinetic test and three function tests are used in our

assessment. A 25-point score is awarded to each test based on a percentage of limb symmetry. The resultant 100 points is calculated into the functional test score. Isokinetic measurements using a Lido active system (Loredan Biomedical, Sacramento, Calif) are taken at  $60^\circ$  and  $240^\circ/s$ . Parameter emphasis as related to isokinetic scoring is as follows: quadriceps total work, quadriceps average peak torques, hamstring total work, followed by hamstring average peak torques. A leg press test is administered using a Bodymaster (Rayne, La) leg extension machine to assess lower extremity muscle endurance. Resistance is set at 60% of the patient's body weight. Range of motion during the test is  $85^\circ$  to  $5^\circ$ . Unilateral concentric action followed by an eccentric action in a slow controlled motion equals one repetition. The patient continues until fatigue and the total number of repetitions on each leg is recorded. Limb symmetry is calculated and awarded the appropriate score. The one-leg hop test is used to assess lower extremity power. Each limb performs two hops, and the mean distance is calculated to determine limb symmetry. The appropriate score is awarded. A box ( $2' \times 2'$ ) quadrant test is administered to assess agility and neuromuscular coordination. The patient receives one point for every quadrant hopped into continuously on each limb in a clockwise direction for a 15-second bout. This procedure is repeated in a counterclockwise direction. The mean of both jumps is calculated and used to determine limb symmetry. The appropriate score is awarded. This functional test score is being used now at our facility to better assess an athlete's return to sport following a multitude of lower extremity injuries, including postoperative ACL and PCL reconstructions.

### **Effect of Body Position and Velocity on Eccentric Hamstrings Peak Torque Measures**

Brown R, Kimura I, Sitler M, Kendrick Z. Temple University, Philadelphia, PA 19122

The purpose of this study was to

compare the effect of seated, prone, and supine body positions on eccentric hamstrings peak torque data when using the Biodex Isokinetic Exercise machine at 60° and 120°/s. The right hamstrings of 34 asymptomatic female Temple University volunteers were tested, using the eccentric mode of the Biodex isokinetic dynamometer. Each subject was tested in the seated, prone, and supine body positions at 60° and 120°/s. Test positions and velocities were assigned randomly, and peak torque was gravity-corrected. Subjects participated in practice and data collection sessions separated by no less than 7 and no more than 14 days. Both test sessions consisted of a four repetition warm-up followed by five maximum eccentric contractions at each body position and velocity. A 1-minute rest period was administered after each warm-up, a 5-minute rest period was administered between testing velocities, and a 10-minute rest period was administered after the completion of each body position to allow subjects to recover and for adjustment of the Biodex. An analysis of variance with repeated measures was used to examine the eccentric hamstrings peak torque data differences among test conditions. A significant difference was revealed at the  $p < .05$  alpha level, among body positions. A Tukey post hoc test revealed a significantly ( $p < .05$ ) higher peak torque generation in the prone body position when compared to the seated and supine body positions. Statistical analysis indicated that within the limits of this study, there were no significant differences between velocities for each test condition at the .05 alpha level. However, significant differences were present at the .06 alpha level. The results of this study demonstrated greater mean peak torque values at 120°/s when compared to 60°/s in all three body positions.

### **Cardinal Plane Isokinetic Shoulder Strength as Predictors of Isokinetic Diagonal Plane Strength**

Hutchinson B, Linney M, McFarland CJ, McCloy C. Slippery Rock University, Slippery Rock, PA 16057

The purpose of this study was to

determine if shoulder cardinal plane strength values predict diagonal pattern strength using a Cybex II isokinetic dynamometer. Twenty healthy male volunteers (25.8±3.7 yr, 70.3±2.8 in, 183.1±27.0 lb) with no history of shoulder injury were tested in three single plane movements: internal/external rotation, flexion/extension, and abduction/adduction. In addition, each subject was tested in a diagonal pattern. All subjects were tested at 90° and 180°/s. Multiple regression with forced data entry was conducted to determine if strength measures of the component cardinal plane movements were predictive of the diagonal pattern strength values. Peak torque values for cardinal plane flexion, adduction, and external rotation explained 72% of the variance in diagonal flexion peak torque at 90°/s and 67% at 180°/s. Cardinal plane extension, abduction, and internal rotation explained 60% of the variance in diagonal extension peak torque at 90°/s and 57% at 180°/s. The diagonal patterns tested are considered more functional movement patterns than the cardinal plane movements. The component cardinal plane strength values are moderately predictive of diagonal pattern strength. These results suggest clinicians should test shoulder strength in a diagonal pattern when attempting to evaluate functional strength.

### **Reliability of Isokinetic Shoulder Strength Measures in Cardinal Planes and a Diagonal Pattern**

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The purpose of this study was to estimate the reliability of shoulder cardinal plane and diagonal pattern strength measures. Eight males (25.1±2.8 yr, 69.6±3.8 in, 168.8±20.6 lb) with no history of shoulder injury were tested in three cardinal plane movements (internal/external rotation, flexion/extension, and abduction/adduction) and a diagonal pattern (flexion/adduction/external rotation: extension/abduction and internal rotation). All subjects were tested at 90° and 180°/s. The subjects returned for retest-

ing within 25 days of their original test ( $\bar{x}$ =14.8 days;  $SD$ =7.7) to permit estimating the reliability of isokinetic testing in the four different patterns. Intraclass correlation coefficients (ICC) and standard error of measurement (SEM) were calculated for peak torque (PT), strength ratios (ie, flexion PT/extension PT, etc) and torque accelerated energy (TAE). Statistical analysis demonstrated low to moderate reliability for strength ratios in all patterns and speeds [ICC (2,1)=.20-.73; SEM=3.68-9.43%]. Peak torque & TAE were moderately to very reliable [ICC(2,1)=.51-.91; SEM=2.02-7.36 ft-lbs (PT); and .41-.91; SEM=.51-2.01 ft-lbs (TAE)]. Overall, the diagonal pattern strength values demonstrated greater reliability than cardinal plane values, and testing peak torque at 180°/s was more reliable than 90°/s. These findings suggest that clinicians should not rely on strength ratios as a measure of progress and use caution when interpreting peak torque and TAE values.

### **Influence of Short Arc Isotonic Knee Extensions and the NordicTrack on Reduction of Patellofemoral Pain**

Hector L, Kimura I, Sitler M. Temple University, Philadelphia, PA 19122

The purpose of this study was to investigate the influence short arc isotonic knee extensions and the NordicTrack had on reducing pain of subjects with patellofemoral pain syndrome. Subjects were 14 female interscholastic athletes between the ages of 13 and 18 years. All subjects were diagnosed with patellofemoral pain syndrome by an orthopaedist. All subjects, on their initial visit, completed the short form of the McGill Pain Questionnaire (SF-MPQ), iced their knees, stretched their hamstring muscles, performed isometric quadriceps contractions, completed the SF-MPQ, and again iced their knees. The subjects were scheduled for treatment 3 days a week, and their treatment protocol consisted of the following routine: SF-MPQ completion, knee icing, hamstrings stretching, straight leg raise exercises, SF-MPQ completion,

and knee icing. When the subjects were able to perform a single leg raise with a 5-lb weight attached to their ankle, they were assigned randomly to the NordicTrack group or the short arc isotonic knee extension group on their next scheduled visit. The subjects continued in these groups for 2 consecutive weeks for a total of six treatments. The SF-MPQ was administered to all subjects before and after each treatment which provided a raw score for the amount of perceived pain during treatment. Pain Rating Index (PRI) and Present Pain Inventory (PPI) data were obtained from the questionnaire. Two-way analysis of variance (ANOVA) with repeated measures was used to analyze the PRI and PPI data. The ANOVA F values indicated significant differences at the  $p < .05$  level between treatment sessions for the PRI and PPI. Tukey post hoc tests performed on the PRI and PPI data comparing different test sessions were not significant at the  $p < .05$  level. Significant differences were also seen in both treatment groups between the pre- and post-treatments PRI and PPI data. The means of both groups indicated that NordicTrack and short arc isotonic knee extension subjects experienced increases in pain during the last six treatment sessions. The F value obtained revealed no significant differences at the  $p < .05$  level between the NordicTrack group and short arc isotonic knee extension group with regard to perceived pain during the pretests and posttests. Recommendations for further study include: increase the sample size to include a broader population and increase the treatment time once subjects are divided into separate groups.

### **Effects of Eccentric vs Concentric Training on Functional Motor Performance Skills of College Football Players**

Connelly G, Kendrick Z, Kimura I, Sittler M. Temple University, Philadelphia, PA 19122

The purpose of this study was to compare the effects of eccentric and concentric training on two selected

motor performance skills. Fifteen Division III college football players were assigned randomly to one of three groups: eccentric training, concentric training, and control. The eccentric training group performed a modified Daily Adjusted Progressive Resistance Exercise leg extension program for the eccentric phase only. The concentric training group performed the same modified Daily Adjusted Progressive Resistance Exercise leg extension program for the concentric phase only. Both groups of subjects performed the exercise on the Polaris variable resistance machine (Polaris Fitness Equipment, Spring Valley, Calif). The control group performed its normal off-season conditioning program. All groups completed their training twice a week for eight weeks. The modified Sargent Jump test and standing broad jump tests were used to pretest and posttest all groups. Two days rest was given to the three groups before posttesting data were obtained. Analysis of variance revealed significant difference ( $p < .05$ ) between the eccentric training group of subjects and the control group of subjects for the modified Sargent Jump; eccentrically trained subjects jumped farther. Although pretest to posttest scores for the eccentrically trained subjects were greater than those of the concentrically trained subjects, these differences were not significant. There was no significant difference between the groups for the standing broad jump. It was concluded from this study that eccentric training may assist athletic performances that require vertical jump activities.

### **Enhancing Injury Rehabilitation: A Proposed Model for Psychological Skills Training**

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Injury caused by athletic participation continues to be an inherent risk factor for all athletes. When the extent of an injury is severe enough to require modified activity, immobilization, and/or surgery, rehabilitation is imminent. Unfortunately, however, many athletic injury rehabilitation programs

focus only on the physical aspects of the injury, thereby neglecting the mind-body connection (Ermler & Thomas, 1990). Research (Iveleva & Orlick, 1991) has indicated that the injury rehabilitation process can be facilitated by including appropriate psychological strategies into the program. This paper focuses on a model that can be used by the sports medicine team as a guide for incorporating psychological strategies into the rehabilitation process. The four-stage model offers suggestions for strategy implementation prior to, during, and at the conclusion of the athletic injury rehabilitation program. In addition to discussing the model, data will be presented that highlights the views of collegiate student-athletes regarding their knowledge, interest, and beliefs about the psychological variables associated with the injury cycle and the rehabilitation process. Finally, recommendations for training sports medicine professionals in the use of psychological strategies will be provided.

### **Risk Factors for Noncontact Anterior Cruciate Ligament Injuries in High School and College Athletes: A Follow-up Study**

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Excessive subtalar pronation and anterior knee joint laxity were identified by Woodford et al (1990) and Cyphert et al (1991) as risk factors for anterior cruciate ligament (ACL) injury. The purpose of this follow-up study was to determine if measures of navicular drop from resting position and leg length discrepancy, in addition to previously studied variables of navicular drop from subtalar neutral, goniometric measures of rear foot motion and KT-1000 measures of knee joint laxity, predict risk of ACL injury. Fifteen athletes with unilateral, noncontact ACL injuries were matched by sport, position, height, weight, and playing time in an attempt to control for exposure to injury. Measures of navicular drop, navicular drop from subtalar neutral, calcaneal

eversion, and anterior knee joint laxity using a KT-1000 were taken on the uninjured leg of the ACL injured athletes and bilaterally on the uninjured athletes. Leg length also was measured bilaterally on all athletes. Discriminant analysis resulted in navicular drop from subtalar neutral being retained. Classification of athletes through a regression equation resulted in 11 of 15 injured and 13 of 15 uninjured athletes (24/30 or 80% overall) being classified correctly. These results are in agreement with previous reports suggesting that hyperpronation may increase the risk of ACL injury. These results also suggest that of the predictor variables studied, navicular drop from subtalar neutral may be the most useful clinical measure to identify athletes at risk.

### **Injury Patterns in Collegiate Baseball**

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Currently there are no published studies of injury rates or patterns in collegiate baseball. The goals of this study were to evaluate the distribution and severity of injuries in a collegiate baseball program. All injuries were prospectively recorded from our Division I baseball team from 1990-1992 using the Sports Injury Management System computer system. A reportable injury was considered as one that required medical attention from the team trainer. For all injuries, the overall time lost from competition was 153 games, and from practice, 195 sessions. The number of minor injuries (less than 7 days lost) was 191 (95%), moderate injuries (7-20 days lost) was 0, and severe injuries (21 days and above) was 11 (5%). Of the 11 severe injuries, 4 required surgery. The exposure rate for the 1990-1991 season was 9.48/1000 and for the 1991-1992 season was 46.58/1000. The etiology of injury was fielding 23%, throwing 22%, base running/sliding 13%, batting 12%, and conditioning 10%. For all players, the upper extremity was injured 51% of the time, with the shoulder (49%), hand (24%), and elbow (14%) the most common injuries. The most common problem was shoulder tendinitis. The lower

extremity was injured 49% of the time, with the thigh (28%), ankle (24%), and leg (23%) the most common injuries. The thoracic/lumbar spine comprised 11% of the injuries. The most frequently injured players were pitchers (33% of total), infielders (29%), outfielders (22%), and catchers (16%). The shoulder was injured as frequently in infielders as in pitchers, but more time was lost by pitchers. Based upon the study, we recommend and have instituted rotator cuff strengthening programs for infielders as well as pitchers. Lower extremity injuries in baseball are more common than previously appreciated.

### **Bioelectrical Impedance Measurements of Hydration Effects on Muscular Strength and Endurance in College Wrestlers**

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In this study, bioelectrical impedance analysis (BIA) was used to monitor total body water (TBW) during weight cycling (WC) in wrestlers. It was hypothesized that WC and subsequent TBW changes would alter dominant muscular strength (MS) and endurance (ME) of the adductors (Lat Dorsi; Pect Major; Teres Major & Minor; abductors (Deltoid & Supraspinatus). Nineteen wrestlers (18.91.3 yr) were tested prior to the preseason (PS). Four and one-half months after the PS testing, PostTest1 (PT1) and PostTest2 (PT2) were conducted within a 7-day period. PT1 was conducted after 4 days of hydration. PT2 was conducted 2 to 3 hours prior to making weight for the final match. A Valhalla BIA 1990B was used to measure TBW. An Orthotron II measured dominant isokinetic adductor/abductor shoulder MS & ME. Results of MANOVA indicated significant changes in TBW; adductor MS & ME; & abductor MS & ME ( $p < .05$ ). Tukey's HSD test ( $p < .05$ ) revealed changes occurred in TBW between PS & PT2, as well as between PT1 & PT2. It was anticipated after a season of WC that a state of chronic dehydration would exist at the time of PT1. However, it appeared

significant TBW changes occurred only at times of acute dehydration (PT2). Actual differences in adductor MS were found between PS & PT1 and between PS and PT2. The differences in adductor ME were found between PS and PT2 and between PT1 and PT2. Abduction MS was affected in all stages of the study, with abduction ME showing significant difference between PS & PT2 and between PT1 & PT2. ME appears to be affected only during acute dehydration. Whereas, MS was affected differentially under the same conditions.

### **Effect of the Aircast Pneumatic Armband and Pro Tennis Elbow Strap on Torque Output during Concentric Wrist Extension**

Wolff BE, Kimura IF, Sitler M, Kendrick Z. Temple University, Philadelphia, PA 19122

Forearm support straps have been used for the relief of some symptoms associated with lateral epicondylitis; however, there has been some disagreement in the literature regarding the effect that the forearm supports have on muscle contraction of the wrist extensors. The purpose of this study was to analyze the concentric torque output and maximum repetition work (MRW) produced by the right wrist extensors of 30 asymptomatic male subjects during six braced and unbraced test conditions. Test conditions were performed on a Biodex system set at isokinetic velocities of 30° and 120°/s while wearing the Pro Tennis Elbow Strap, the Aircast Pneumatic Armband, and a control condition in which no support was applied to the forearm. The effect of the test conditions and velocity of contraction was analyzed using two-way analyses of variance (ANOVA) with repeated measures ( $p < .05$  level). No significant difference was found in peak torque or MRW values between the braced and unbraced test conditions and test velocities. A nonsignificant decrease in torque output was seen in all test conditions except when the Aircast Pneumatic Armband was applied to the forearm at 30°/s in which an increase in torque was noted. Although forearm

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supports may relieve the subject's pain upon return to activity, debate still exists in regard to the how the braces affect forearm musculature, and ultimately the strength produced by the wrist extensor muscles. Continued research needs to be conducted to investigate the effect that forearm supports may have on muscle contraction of subjects with a history of trauma to the wrist extensor tendons.

### **Epidemiology of Injury and Illnesses at the United States Olympic Sports Festival 1990**

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The volunteer medical staff reported

injury and illness information during the Olympic Sports Festival in Minneapolis in August of 1990. The purpose of the presentation was to show the numbers, body parts injured, severity of injury, type of injury, and illnesses in these elite athletes. Every injured or ill athlete was seen by a member of the medical staff who completed a detailed form. A new report was completed for each injury or illness. The forms were analyzed for type of sport, male or female, time lost, time of injury, body part injured, diagnosis, need for radiographs, medications used, and other treatment. A total of 3111 athletes participated. 1750 were males and 1361 were females. There were 1357 injury reports completed. The most common injury was a strain, then sprain, then contusion. The

most common illness was upper respiratory infection. Three athletes required hospitalization. These included a liver laceration in a soccer athlete, closed tibia fibula fracture in a roller hockey athlete, and a concussion in a bicyclist. The sport in order of incidence of injury for males was team handball (86), soccer (58), volleyball (52), ice hockey (42), and track and field (36). The sport in order of incidence of injury for females was team handball (85), judo (64), soccer (56), basketball (45), and field hockey (42). Recognition of injury patterns in the varied sports will enable health care professionals to diagnose and treat conditions with greater success.

# A Comparison of Thermotherapy and Cryotherapy in Enhancing Supine, Extended-leg, Hip Flexion

Julie Minton, BS, ATC

**Abstract:** Eighteen healthy subjects (13 females and 5 males) were pretested and posttested under two treatment conditions in order to compare the effects of cryotherapy and thermotherapy on supine, extended-leg, hip flexion measurements. Cryotherapy treatments consisted of crushed ice bags secured to the posterior thigh for 20 minutes. On a separate day, thermotherapy treatment of moist heat pads were applied to the posterior thigh for 20 minutes. For pretest and posttest measurements, the subject's extended leg was taken to the end feel of passive hip flexion as maximum range of motion was assessed using a goniometer. Both cryotherapy and thermotherapy significantly improved immediate range of motion; however, there were no differences between the two treatment conditions. These results suggest that athletes wishing to obtain maximum range of motion immediately after treatment may select

either ice or heat modalities. Individual conditions and preferences can be used to dictate treatment selection.

**F**lexibility, the range of motion about a given joint, is critical to athletic ability. Benefits of increased flexibility include a decrease in injury rate and an increase in athletic performance.<sup>6,20,22</sup> Thus, one could assume that the modality which provides the athlete with the most flexibility at a given time would be the most advantageous. Research in this area has focused on the use of ice (cryotherapy) and heat (thermotherapy) modalities.<sup>3,5,8,15,21,26</sup> Findings have varied.

Heat has been accepted widely as a means of augmenting range of motion because of its physiological functions of increasing collagen extensibility, increasing blood flow, decreasing pain perception, and decreasing muscle spasms.<sup>7,14,18,21,24</sup> Thermotherapy is associated with a greater increase in flexibility than cryotherapy.<sup>5,26</sup> Local tissue warming improved dynamic flexibility by 20%; however, a decrease in range of motion was found with tissue cooling. Price and Lehman<sup>19</sup> reported that muscle cooling increased elastic and frictional stiffness at the ankle joint,

producing an estimated 3% to 10% increase in total joint stiffness.

Other researchers have reported flexibility gains when using cryotherapy.<sup>3,8,15</sup> Olson and Stravino<sup>15</sup> found cryotherapy to be as effective as thermotherapy in decreasing joint stiffness and increasing joint motion. Neither Holt<sup>8</sup> nor Chambers<sup>3</sup> examined the effects of thermotherapy, but each found positive results on range of motion with the use of cryotherapy. Sapega<sup>21</sup> and Holt<sup>8</sup> especially recommended cryotherapy for flexibility increases when recovering from injury.

Cryotherapy is reported to enhance joint stretching by decreasing pain perception, interfering with muscle spasm, and possibly causing reflex vasodilation. It appears each modality's effectiveness can vary with the temperature reached in the underlying tissue, as well as with the condition of the joint and muscles to be stretched.<sup>7,21</sup>

Flexibility needs are both sport- and individual-specific. Straight-leg hip flexion is considered to be an important fitness attribute because of its relationship to the hamstrings. The hamstring musculature is recognized as the primary inhibitor to extended-leg hip flexion.<sup>14,17</sup> Decreased hamstring range of motion is theorized to be a precursor to conditions such as hamstring strains and low back pain.<sup>17</sup> Hamstring flexibility exercises with supine, extended-leg, hip flexion stretches are often an essential component of a flexibility program.<sup>2</sup>

Based on the conflicting results of past research and the importance of good flexibility, further research in this area appears warranted. The purpose of this study was to determine if either thermotherapy or cryotherapy was significantly superior to the other in producing immediate flexibility gains in supine, extended-leg, hip flexion.

## Methods

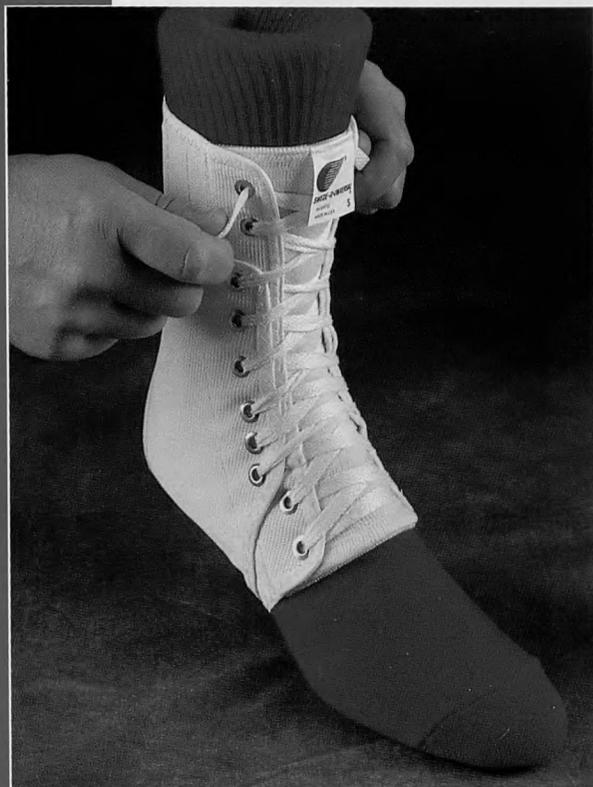
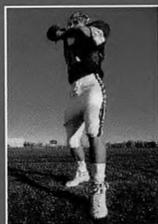
Eighteen healthy volunteer subjects (n = 13 females, n = 5 males) were

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Julie Minton received a bachelor's degree in physical education/athletic training from James Madison University. She is currently a graduate student in the Physical Therapy program at the University of Delaware in Newark, DE 19711.

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pretested and then posttested following a cryotherapy or a thermotherapy modality. The subject pool consisted of healthy undergraduate students from James Madison University. Static flexibility was determined with a passive, straight-leg, hip flexion, partner stretch. A JAMAR® (Clifton, NJ), 6-inch, double-arm goniometer was used to measure maximum range of motion.

The subject lay supine on a treatment table. The right leg was extended fully, with the ankle placed in a neutral position. The partner stabilized the left leg on the treatment table and grasped the right ankle and anterior knee. The hip was flexed passively until the subject

was at maximum tolerance of discomfort and tightness in the hamstring musculature.<sup>16,17</sup> The stretch was held until a goniometric measure could be obtained. A 10-second rest between two trials was given, and the greatest of the measurements was recorded.

Using the procedure indicated, pretest measurements were obtained. Gallon bags of crushed ice were applied directly to the length of the posterior thigh and secured with an elastic wrap. Posttest measurements were assessed immediately following a 20-minute cryotherapy application.

On a different day than cryotherapy testing, thermotherapy testing was per-

formed. Pretest flexibility measurements were obtained. Hydrocollator moist heating pads were applied to the entire length of the posterior thigh and secured with an elastic wrap. As before, posttest flexibility measurements were determined following 20 minutes of moist heat application. A two-way analysis of variance (ANOVA) with one repeated measure was computed to determine if significant differences existed between treatment conditions (pre to post) and between treatment groups ( $p < .05$ ).

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standard deviations for the two treatment conditions (pre and post) are presented in Table 1. Analysis of variance revealed significant differences between pretest and posttests for each treatment effect ( $F(1,34)= 59.7, p=.0001$ ). However, there was no significant difference between the treatment effects. No interaction between treatment effects was found. A power analysis<sup>9</sup> conducted on the data was found to be .60. This value was deemed acceptable for the scope of the study.

## Discussion

The physiological effects of both ice and heat have been well-documented.<sup>7,10,11,15,18,21,24,25</sup> Cryotherapy is extremely valuable in acute situations because of its inhibitory physiological effects.<sup>15,18</sup> Thermotherapy, however, is used more widely for postacute and chronic situations due to its facilitative physiological functions.<sup>18</sup> Although thermotherapy and cryotherapy appear to produce opposite effects when local temperature, blood flow, metabolism, edema formation, cell permeability, and nerve conduction velocity are considered, both modalities may enhance flexibility. Statistical analysis of the data in this study found that both ice and heat modalities significantly improved pretest to posttest hamstring flexibility measurements. Neither modality proved to be significantly more effective than the other.

These findings are contrary to the results of others<sup>5,26</sup> who demonstrated a 20% increase in flexibility with thermotherapy treatment and a decrease in flexibility with cryotherapy treatment. They are, however, consistent with the research that suggested that both

cryotherapy and thermotherapy have the capacity to enhance stretching.<sup>3,8,15</sup> The present study did not examine the physiological reasons behind the increases in flexibility found. However, previous research on flexibility and the effects of stretching, thermotherapy, and cryotherapy suggests insight into possible explanations.

Most, if not all, of the resistance to stretch is derived from the connective tissue structures in and around muscles, not from myofibrillar elements, according to Sapega.<sup>21</sup> As tissue temperature increases, the biomechanical characteristics of collagen change to increase the viscous flow of collagen fibers. Subsequently, connective tissue extensibility increases; thus range of motion may also increase.<sup>13,24</sup> At 104°F, a thermal transition occurs in the microstructure of collagen.<sup>13</sup> The transition is probably a result of partial destabilization of the intermolecular bonding.<sup>13</sup> This process allows greater stretching because of the breakdown or relaxation of collagenous tissue.<sup>13,21</sup> Thermotherapy also may contribute to increases in flexibility because of a relaxing psychological response on the part of the subject.<sup>7</sup> The increased blood flow and the superficial rise in temperature create a feeling of warmth and relaxation and may produce a positive attitude toward stretching.<sup>7</sup>

Cryotherapy's benefits to stretching are not understood as well. Some researchers have believed in periods of reflex deep tissue vasodilatation occurring with cryotherapy treatment.<sup>4,18</sup> Clarke et al<sup>4</sup> reported an increase in blood flow throughout a 45-minute period of ice treatment. The vasodilatation in the deep tissue was theorized to increase blood flow from the previously diminished flow that accompanied the

cold and vasoconstriction.<sup>23</sup> Blood flow could even remain elevated for 50 minutes following cryotherapy treatment.<sup>23</sup> It is this blood flow returning to the cold area that has been theorized to ameliorate stretching.<sup>25</sup> However, cold-induced vasodilation is only theory; some researchers refute the hypothesis.<sup>10,12</sup> Knight and Londeree<sup>12</sup> found the opposite of cold-induced vasodilatation when they measured ankle blood flow during six combinations of heat, cold, and exercise. Blood flow remained depressed for 20 minutes following ice application. Knight<sup>10,12</sup> concluded that previous studies demonstrating cold-induced increases in blood flow are questionable due to methodology, and that an increase in temperature does not automatically assume an increase in blood flow to an area.

Both thermotherapy and cryotherapy appear to enhance static flexibility by inhibiting muscle spasms and pain perception.<sup>18</sup> Cold therapy slows down metabolism in an area to decrease waste products serving as muscle irritants causing muscle spasms and increases the muscle viscosity to slow down the muscle's ability to contract and spasm.<sup>18</sup> Cryotherapy's effects on muscle spasms are also the result of direct sensory stimulation of primary and secondary muscle spindle afferent fibers and indirect reflex inhibition which decreases gamma activity and lowers the muscle spindle's threshold to interfere in the muscle excitability.<sup>13,18</sup> Cold sensations interfere in the muscle spasm signals and the contracting myostatic reflex signals of the muscle fibers to break the spasm/pain cycle, allowing the muscle to be stretched more fully.<sup>13</sup> Heat also interferes in the muscle spasm cycle when ischemia is involved. Vasodilatation increases blood flow to the area in need to decrease spasms due to a lack of nutrients and blood supply.

The analgesic effect on pain is believed to be due to the gate theory of pain.<sup>18</sup> The heat or cold sensation sends impulses to the spinal cord through the cutaneous afferent pathways. These sensations close the gate so that the pain from the muscle stretch cannot pass along the slower-conducting pain pathways.<sup>7</sup> Reducing or delaying the trans-

**Table 1. - Degrees of Flexibility for Treatment Conditions (Mean±SD).**

	Pretest	Posttest
Cryotherapy	101.5±17.1	106.9±17.5
Thermotherapy	101.4±17.0	109.2±16.0

aP<.05

mission of pain allows one to stretch further before the interference of pain limits range of motion. Cooling a muscle also decreases muscle spindle sensitivity to stretch and inhibits the myostatic stretch reflex.<sup>7</sup> Muscle spindles react to stretch and the rate of change of stretch by reflexively contracting the muscle to prevent further stretch. If the signals to contract are delayed or inhibited because of cold, a greater stretch is allowed.

Although we found no significant difference between cryotherapy and thermotherapy, prior results suggest that cryotherapy should be the modality of choice when dealing with an injured area. Sapega et al<sup>21</sup> suggested that the greatest benefits of cryotherapy occur when the goals are to increase flexibility by tearing connective tissue (ie, scar tissue) when the body area is so painful that analgesia is needed for stretching, or when spasticity significantly interferes with range of motion. Only healthy individuals were examined in the current study. Therefore, further research using both healthy and injured subjects to examine the relationships of cryotherapy and thermotherapy to injury and flexibility stretching is warranted.

Other considerations to address are depth of penetration and heat transfer needed to obtain the desired physiological effects. Both thermotherapy and cryotherapy techniques used in this study were forms of superficial exposure. Depth of penetration and rate of transfer from these modalities vary with tissue thickness and consistency, surface area exposed to treatment, and the temperature difference between the heating agent and the area covered.<sup>18</sup> It is believed generally that cold treatments are more effective in reaching deep tissue than most superficial heating agents.<sup>18</sup> With standard hot pack application for 20 minutes, muscle temperature elevation at a depth of 3 cm can be expected to be 1°C or less.<sup>1</sup> Adipose tissue with a low thermal conductivity insulates against heat, acting as a barrier to heat penetration of underlying tissue from superficial heating agents and retaining heat loss with cold agents. Adipose tissue thickness, as

well as muscle thickness, varies per individual. For further research, it might be advantageous to take a skinfold assessment of the area to be treated. More strict temperature controls also would increase validity. This study assumed constant temperature between individual skin surfaces and heat pack or ice pack application. Knowing subcutaneous thickness and tissue difference may influence the length of treatment necessary for desired effects.

Findings from this study suggest that an athlete may select either cryotherapy or thermotherapy modalities for the purpose of optimizing the effects of stretching. The choice should depend on the condition of the joint and surrounding tissues, as well as the individual preference for ice or heat. Treatment application time should be sufficient to allow for desirable physiological effects to occur.

The results of this study are slightly tempered due to the power level of .60. To increase the sensitivity of the statistical design, a future study with a larger subject pool is needed. Future research also should examine the effect of a time interval between treatment and posttesting. There is usually a time delay between treatment and athletic performance; therefore, it would be valuable for an athletic trainer and an athlete to know the appropriate time for treatment in order to receive maximum flexibility gains.

### Acknowledgments

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### References

1. Abramson DI. Changes in blood flow, oxygen uptake, and tissue temperatures produced by the topical application of wet heat. *Arch Phys Med Rehab.* 1961;42:305.
2. Beaulieu JE. Developing a stretching program. *Phys Sportsmed.* November 1981;9:132-139.
3. Chambers R. Clinical uses of cryotherapy. *Phys Ther.* 1969;49:245-249.
4. Clarke RSJ, Hellan RF, Lind AR. Vascular reactions

- of the human forearm to cold. *Clin Sci.* 1958;17:165-179.
5. deVries HA. *Physiology of Exercise for Physical Education and Athletics.* Dubuque, Iowa: Brown Publishers; 1966:368.
6. Felton EA. *A Kinesiological Comparison of Good Performers (and Poor) in the Standing Broad Jump.* Madison, Wis: University of Wisconsin; 1960. Thesis.
7. Halvorson GA. Therapeutic heat and cold for athletic injuries. *Phys Sportsmed.* May 1990;18:87-92.
8. Holt LE. *Scientific Stretching for Sport.* Halifax, Nova Scotia: Dalhousie University; 1973. Thesis.
9. Keppel G. *Design and Analysis: A Researcher's Handbook.* Englewood Cliffs, NJ: Prentice Hall; 1973:549.
10. Knight KL. *Cryotherapy: Theory, Technique and Physiology.* Chattanooga, Tenn: Chattanooga Corporation; 1985:83-89.
11. Knight KL. Effects of hypothermia on inflammation and swelling. *Athletic Training, JNATA.* 1976;11:7-10.
12. Knight KL, Londree BR. A comparison of blood flow in the ankle of uninjured subjects during therapeutic application of heat and cold, and exercise. *Sci Sport Exerc.* 1980;12:76-80.
13. Lehman JF, Mascock AS, Warren CG, Koblanski JN. Effect of therapeutic temperature on tendon extensibility. *Arch Phys Med Rehab.* 1970;57:122-126.
14. Norkin CC, White DJ. *Measurement of Joint Motion: A Guide to Goniometry.* Philadelphia, Pa: FA Davis Company; 1985:6.
15. Olson JE, Stravino VD. A review of cryotherapy. *Phys Ther.* 1972;52:840-853.
16. Prentice WE. A comparison of static stretching and PNF stretching for improving hip joint flexibility. *Athletic Training, JNATA.* 1983;18:56-59.
17. Prentice WE. *Rehabilitation Techniques in Sports Medicine.* St. Louis, Mo: Times Mirror/Mosby; 1990:47.
18. Prentice WE. *Therapeutic Modalities in Sports Medicine.* St. Louis, Mo: Times Mirror/Mosby; 1990:90-92.
19. Price R, Lehman JF. Influence of muscle cooling on the viscoelastic response of the human ankle to sinusoidal displacements. *Arch Phys Med Rehab.* 1990;71:745-748.
20. Reser JM. *The Effects of Increased Range of Motion on Vertical Jump.* Los Angeles, Calif: UCLA; 1961. Thesis.
21. Sapega AA, Quedenfeld TC, Moyer RA. Biophysical factors in range of motion exercise. *Phys Sportsmed.* December 1981;9:57-65.
22. Shellock FG, Prentice WE. Warming up and stretching for improved physical performance and prevention of sports related injuries. *Sports Med.* 1985;2:267-278.
23. Wagner JM, Bell GM. Assessment of calf blood flow in the female in response to the application of cold as measured by impedance plethysmography. *Athletic Training, JNATA.* 1990;25:120.
24. Warren CG, Lehman JF, Koblanski JN. Heat and stretch procedures, an evaluation using rat tail tendon. *Arch Phys Med Rehab.* 1976;51:481-487.
25. Wilmore HJ. *Athletic Training and Physical Fitness.* 3rd ed. Boston, Mass: Allyn & Bacon; 1977:176.
26. Wright V, Johns R. Physical factors concerned with the stiffness of normal and diseased joints. *Bull John Hopkins Hosp.* 1960;106:215.

**Abstract:** Athletic trainers should be familiar with the educational background of the physicians with whom they interact. They should be aware of the educational steps involved for a physician from medical school through specialty training. It is highly desirable for sports medicine physicians to complete fellowship training or participate in appropriate continuing education courses. Athletic trainers should encourage suitable education to assist the physicians with whom they interact to be credible sports medicine specialists.

### Commentary:

The first time I saw the words "Sports Medicine" was in 1980, as a student in college. I had gone over to the football stadium to watch spring practice and was turned away by a person wearing a T-shirt bearing those words. That experience aroused in me an interest which has effectively changed my life and career. Now, 13 years later, after majoring in physical education, becoming certified as an athletic trainer, graduating from medical school, completing a family practice residency, finishing a fellowship in Primary Care Sports Medicine, and joining a group of fellowship-trained sports medicine orthopaedic surgeons, I feel I am beginning to understand what "Sports Medicine" is.

Sports medicine means different things to different people. To the athletic trainer, it means athletic training. To the orthopaedic surgeon, it means orthopaedic surgery. To the primary care sports medicine physician, it means primary care sports medicine. To an athlete, it means prevention of and rehabilitation after injury. To the lay public, it may mean a combination of

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# "All Physicians Are Not Created Equal." Understanding the Educational Background of the Sports Medicine Physician

Brent S. E. Rich, MD, ATC

these things. John Lombardo, a family physician and president of the American Medical Society for Sports Medicine, defines it as "the application of principles and concepts of medicine to physical activity and those who participate in sports, games, and other physical activities."<sup>2</sup>

Sports medicine is a field of comprehensive medical and therapeutic care for people involved in fitness activities. It is not dominated by any one specialty or specialty group. The purpose of this commentary is to discuss the comprehensive focus of the field of sports medicine and to educate athletic trainers to recognize credibility in the physicians with whom they interact.

### The Umbrella Concept

Sports medicine has been referred to as an umbrella with different specialties representing the ribs of the umbrella and the athlete representing the stem.<sup>1</sup> Depending upon how broad sports medicine is defined determines the circumference of the umbrella. Athletic training, physical therapy, exercise physiology, nutrition, sports psychology, coaching, and traditional medicine generally are accepted as contributing to the field of sports medicine. Other professionals that could contribute to a broader definition include biomechanists, podiatrists, chiropractors, dentists, nurses, and administrators.

### The Physician Focus

Medicine is one half of the phrase

"sports medicine." Therefore, can one conclude that, in order to provide sports medicine care, one needs to be a physician? Some physicians may argue that point with their nonphysician peers. Currently, in the United States, practicing the medical aspects of sports medicine does not require special certification. Any physician can independently declare himself/herself a sports medicine specialist. On the contrary, to become a certified athletic trainer requires numerous hours and years of special training. Athletic trainers should be aware of the requirements necessary for a physician to become a qualified sports medicine professional. For the purpose of the discussion, the term "physician" will imply licensed medical doctors (MDs) or doctors of osteopathic medicine (DOs).

Medical school is an intensive 4-year curriculum of study beyond an undergraduate degree. The first 2 years of both MD and DO medical school are devoted to intensive classroom education in the medical sciences (ie, anatomy, physiology, biochemistry, microbiology, pharmacology, pathology, etc). During the junior and senior years of medical school, clinical rotations are performed in a core curriculum (ie, surgery, obstetrics, internal medicine, psychiatry, pediatrics) and an elective curriculum (ie, family practice, orthopaedic surgery, radiology, gastroenterology, cardiology, pulmonology, etc). Upon successful completion of academic coursework,



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acceptable evaluations on clinical rotations, and passing scores on standardized national examinations, the student is awarded a medical degree. The major differences between MD and DO medical education are that increased emphasis is placed upon the physical exam and manipulative skills and there is a stronger curricular emphasis on the neuromusculoskeletal system in the schools of osteopathic medicine.

Upon completion of medical school, a physician enters residency training of which the first year is called the internship. In residency training, the physician becomes a specialist in a chosen field. The length of residency training varies, depending upon the specialty. Passing a final national board examination and completion of one year of postgraduate training is required before a physician can acquire a medical license in most states. Obtaining a medical license does not imply completion of specialty training. The physician who completes an internship but does not pursue further specialty training is a "general" practitioner, although this physician can **call** himself/herself a "specialist" regardless of competence level or educational background. Successful completion of residency training allows the physician the right to refer to himself/herself as a specialist.

Board certification is granted when the physician successfully passes a national board exam specifically designed for the specialty. Physicians do not need to be board-certified to practice medicine, although it adds respectability to their credentials. Fellowship training is a 1- to 2-year post-residency educational experience in which a physician can develop further specialization within a field of medicine.

### Application To Sports Medicine

As mentioned above, sports medicine is not a recognized specialty within the field of medicine. Many different types of physicians state that they practice sports medicine, and, as such, their interpretation of sports medicine may not mean the same as that of their peers. Generally, sports medicine

physicians can be categorized broadly into primary care sports medicine specialists or subspecialized sports medicine specialists, most commonly orthopaedic surgeons. Additionally, there are others, such as neurosurgeons, physical medicine and rehabilitation specialists, gynecologists, cardiologists, and others, who practice a significant amount of sports medicine.

The lay public may interpret sports medicine and orthopaedic surgery as being synonymous, but that perception is not necessarily correct. Orthopaedic surgery is much more comprehensive than the treatment of musculoskeletal complaints arising from sports injuries. In reality, sports medicine is a specialty interest within the field of orthopaedic surgery, much the same as joint replacement, spinal surgery, trauma, pediatric orthopaedics, and orthopaedic oncology. Fellowship training for the orthopaedic surgeon requires a 1- to 2-year commitment after a general orthopaedic residency where state-of-the-art surgical and nonsurgical techniques to treat athletic injuries are perfected. In most programs, the physician acts as a team physician or as a consultant to an athletic team. The fellowship-trained orthopaedist can practice general orthopaedic surgery, plus be recognized as a sports medicine expert.

Not all sports medicine requires surgery, nor does it necessarily involve musculoskeletal injuries. Enter the realm of the nonsurgeon. Primary Care Sports Medicine can include any nonorthopaedic branch of medicine, but most commonly includes specialists in family practice, pediatrics, internal medicine, and emergency medicine. These residency-trained specialists not only deal with nonsurgical musculoskeletal issues, but also nonorthopaedic sports "medicine" (ie, exercise prescription, exercise-induced bronchospasm, exercise-induced amenorrhea, eating disorders, sports psychology, exercise in pregnancy, etc) and general medical illness that affects everyone. These professionals have completed residency training and, therefore, are specialists. It is inappropriate to refer to them as general practitioners or generalists. They are much more than "runny nose" doctors

who care for the "nonsignificant" illnesses or injuries that keep athletes from competition. A 1- to 2-year fellowship provides "hands-on" intensive training to develop skills necessary to become a sports medicine specialist and/or team physician. It also provides an opportunity to engage in research related to various aspects of sports medicine. Like their fellowship-trained orthopaedic peers, primary care sports medicine specialists can practice within their specialty field, in addition to being recognized as a sports medicine expert.

Another avenue for the primary care professional to establish credibility is to obtain a Certificate of Added Qualifications in Sports Medicine (CAQ) by passing a comprehensive half-day examination. In order for physicians to sit for the exam, they have to be board-certified in a primary care specialty and either successfully complete a fellowship or demonstrate a commitment to the field with a minimum of 5 years of practice experience and at least 20% of their professional time spent in sports medicine.

### Continuing Education For Physicians

There are several sports medicine organizations that physicians can join to facilitate their interests in the field. These include: the American Medical Society for Sports Medicine, the American Orthopaedic Society for Sports Medicine, the American College of Sports Medicine, the Canadian Academy of Sports Medicine, the American Osteopathic Academy of Sports Medicine, etc. Continuing education courses are offered several times a year during annual and specialty meetings where team physicians and interested sports medicine professionals are exposed to current concepts. Athletic trainers should inquire as to what continuing education their sports medicine specialists are pursuing and encourage further learning, if necessary.

### Physician-Athletic Trainer Interaction

A competent and successful sports

medicine team includes a close working relationship between administrators, athletic trainers, primary care specialists, and orthopaedic surgeons who all realize the need for each other and know their own limitations and expertise. This mutual respect emphasizes that quality medical care must come without interference from individual egos. The administration and athletic trainer should inquire as to the credibility of their physicians and encourage membership in professional organizations, continuing education courses, or obtaining a CAQ, if lacking. The author recommends that the team physician for an athletic team be a primary care physician, with the orthopaedic surgeon serving as a consultant. Though the bulk of sports medicine is musculoskeletal, the majority of it is nonsurgical and, in large part, can be managed by appropriately trained primary care sports medicine specialists. In addition, general medical care of the athlete is treated best by the primary care physician. Primary care providers need to recognize their limitations and determine when prompt referral to an orthopaedic surgeon or subspecialist is indicated.

### Conclusion

Qualified sports medicine physicians are an important component of sports medicine teams. Athletic trainers should inquire about the background of their physicians as part of their responsibility in providing quality sports medicine care. A well-functioning sports medicine team necessitates mutual respect between the physicians, the athletic trainer, the administration, and the athletes.

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### References:

1. Lamb DR. The sports medicine umbrella. *Sports Medicine Bulletin*. American College of Sports Medicine. 1984;19:8-9.
2. Lombardo J. *Sports Medicine Letter*. American Medical Society for Sports Medicine. 1992;12:1.

**Forrest G, Rosen K. Ultrasound treatments in degassed water. *J Sport Rehabil.* 1992;1:284-289.**

Ultrasound is a commonly used modality of deep heating. Two techniques of application have been recommended: a technique in which the applicator head is applied directly to the subject and an immersion technique. The purpose of this study was to determine whether ultrasound treatments using the immersion technique in degassed water are as effective as ultrasound treatments using the direct technique of application in raising the temperature of periarticular structures into the therapeutic range. The limbs of a pig were treated with the direct and immersion techniques of application. Temperatures of the skin surface and of the extensor tendons of the ankle were taken before and after both methods of application. Treatment with the applicator head in direct contact with the limb of the subject was the more effective form of heating.

Reprinted with permission from the *Journal of Sport Rehabilitation.*

**Reisberg S, Verstraete MC. Reusable prophylactic ankle support: a review of the literature. *J Sport Rehabil.* 1992;1:290-299.**

An investigation of the literature on the use of prophylactic ankle braces for preventing lateral ankle sprains reveals methodological flaws and frequently inappropriate extrapolation of results. Existing research is inadequate and not definitive enough to warrant confident use of particular supportive modes. It is therefore apparent that more reliable scientific functional data and empirical conclusions are necessary when researching this topic. Suggestions for further research are offered and encouraged.

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**Westfall DC, Worrell TW. Anterior knee pain syndrome: role of the vastus medialis oblique. *J Sport Rehabil.* 1992;1:317-325.**

Anterior knee pain syndrome (AKPS) represents a significant problem for patients and sports medicine clinicians. Many predisposing factors have been associated with AKPS. Considerable attention has been given to quadriceps strengthening. Specifically, the vastus medialis oblique (VMO) muscle is targeted for selective strengthening. Because of the VMO's oblique attachment to the patella, researchers report that proper dynamic alignment of the patella is dependent on VMO control. Given the lack of scientific information and agreement concerning the rehabilitation of patients with AKPS, the clinician and patient often become frustrated with the lack of progress during rehabilitation. Therefore the purpose of this paper is to clarify the current literature concerning the role of the VMO.

Reprinted with permission from the *Journal of Sport Rehabilitation.*

**Axe MJ, Konin J. Distance based criteria interval throwing program. *J Sport Rehabil.* 1992;1:326-336.**

The decision of how to progress a baseball player through a throwing program following an injury has been a difficult one for the sports medicine population to address. Numerous programs have been suggested to allow a player a gradual return to competitive throwing. These programs are primarily based on previous experience of the clinician designing the program, simply because this may be the only objective material that can be used to determine parameters of a program of such diverse individualism. This paper identifies those components that play a critical

**Clint Thompson, MS, ATC**

role in the design of any interval throwing program and outline a program based on position- and distance-specific phases.

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**Gross MT, Tyson AD, Burns CB. Effect of knee angle and ligament insufficiency on anterior tibial translation during quadriceps muscle contraction: a preliminary report. *J Orthop Sports Phys Ther.* 1993;17:133-144.**

Additional information is needed regarding the effects of exercise protocols on the injured or reconstructed anterior cruciate ligament (ACL). The purpose of this investigation was to assess the effects of knee flexion angle and ACL insufficiency on anterior tibial translation (ATT) and patellar ligament insertion angle as subjects performed maximal isometric quadriceps muscle contractions. The subjects were two females and two males, between the ages of 18 and 24, who had sustained injuries that resulted in unilateral ACL insufficiency. Each subject performed maximum isometric quadriceps muscle contractions with each leg on a CYBEX II dynamometer at each of three positions: 15°, 45°, and 75° knee flexion. A lateral knee roentgenogram was obtained as each subject maintained each isometric contraction. A roentgenogram also was taken as subjects rested on each knee in each of the three target positions. Anterior tibial translation for each isometric muscle contraction was assessed by measuring the anterior displacement of the tibial plateau on the isometric-resisted roentgenogram relative to the resting roentgenogram. Patellar ligament insertion angle was measured also for each roentgenogram. Maximum ATT occurred at the 15° knee flexion target angle for two subjects and

at the 45° target angle for the other two subjects. Patellar ligament insertion angle decreased as knee flexion angle increased. Appreciable stress may be imposed on the ACL as patients perform maximum quadriceps muscle contractions in positions of terminal extension and in midrange positions previously reported as being safe for maximal effort quadriceps exercise. Magnitude of stress imposed on the ACL is discussed as a function of the length-tension relationship of the quadriceps muscle-tendon unit and insertion angle of the patellar ligament. Suggestions are made for additional research regarding appropriate muscle strengthening protocols for patients who have undergone ACL reconstruction.

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**Puniello MS. Iliotibial band tightness and medial patellar glide in patients with patellofemoral dysfunction. *J Orthop Sports Phys Ther.* 1993; 17:144-148.**

This paper investigates the relationship between iliotibial band tightness and medial glide of the patella in

patients with patellofemoral dysfunction. Stretching the iliotibial band has been advocated in the literature to treat patellofemoral dysfunction, but there is little written about the mechanism of its influence on the patella. Anatomy and biomechanics are reviewed, with emphasis on the lateral retinaculum of the knee and the attachment of the iliotibial band to the patella. A study evaluating 17 patients with patellofemoral dysfunction is performed. All patients presented with lateral tracking of the patella on knee flexion and extension. Medial glide of the patella was tested manually, and Ober's Test was performed to test flexibility of the iliotibial band. Twelve of 17 patients exhibited a tight iliotibial band with hypomobility of medial glide of the patella. Three patients demonstrated normal patella mobility with normal result on Ober's Test. Two patients had hypomobile patellae with a normal Ober's Test. This study demonstrates a strong relationship between iliotibial band tightness and decreased medial glide of the patella.

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*Journal of Orthopaedic & Sports  
Physical Therapy.*

**Buxton BP, Perrin DH, Hetzler RK, Ho KW, Gieck JH. Pain and ethnicity in athletes. *J Sport Rehabil.* 1993;2:13-19.**

The purpose of this investigation was to determine the relationship between ethnicity and acute pain response in male athletes. Subjects included 93 male athletes (age=18.7±6 years) of differing ethnicity. Each subject performed a Cold Pressor Test (CPT) and was evaluated for pain threshold and pain tolerance times. Two one-way analyses of variance were performed to analyze the data. The results indicated that significant differences in pain tolerance time existed between ethnic groups ( $p<.05$ ). However, no differences were observed in pain threshold times. These findings support the existence of a difference in pain tolerance between ethnic groups in collegiate athletes.

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# CEU Quiz

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.

To participate in this program, read the material carefully, photocopy the test, and answer the test questions. Mark your answer by circling the cor-

rect letter. Then 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 August 25, 1993.**

A passing score is 70%. We will notify the NATA Board of Certification of all persons who score 70% or better, and the NATA will enter .5 CEU credit on those persons' records. Participation is confidential.

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## Answers to Spring '93 CEU Quiz.

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

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

Berry. *Making yourself mobile with a medical golf cart.*

Grossman, et al. *The athletic prevention programming and leadership education (APPLE) model: developing substance ...*

Piering, et al. *Electromyographic analysis of four popular abdominal exercises.*

Rich. *"All physicians are not created equal." Understanding the educational background of the sports medicine physician.*

Schneider/Morris. *College athletes and drug testing: attitudes and behaviors by gender and sport.*

Salvaterra GF, et al. *An in vitro biomechanical study of the static stabilizing effect of lateral prophylactic knee bracing on ...*

Woodhouse, et al. *Concentric isokinetic trunk extension/flexion testing of rigid and semirigid lumbar/sacral supports.*

Zimmerman GR. *Industrial medicine and athletic training: cost-effectiveness in the nontraditional setting.*

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Please indicate below the setting in which you work:

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## Instructions

1. Photocopy these pages and write on the copy.
2. Read the articles listed above.
3. Answer the questions.
4. Mail with \$15 fee (checks made payable to Indiana State University) postmarked by August 25, 1993, to:

*JAT - CEU Quiz*

**Physical Education Department**

**Indiana State University**

**Terre Haute, IN 47809**

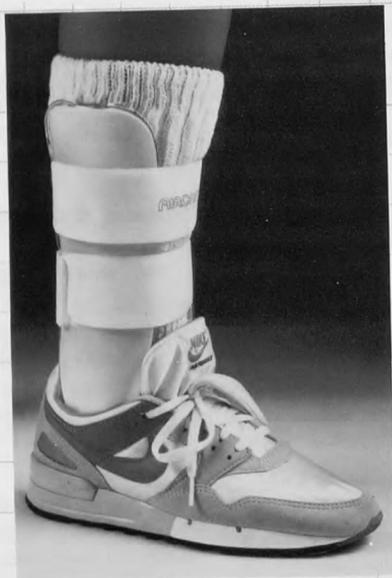
1. A comparison of rigid and semirigid lumbar/sacral supports showed that:
  - a. trunk flexion forces decrease when supportive devices are not used.
  - b. rigid or semirigid trunk supportive devices increase trunk muscle activity.
  - c. rigid support devices significantly reduce isokinetic force.
  - d. None of the above.
  - e. All of the above.
  
2. Contrary to what popular fitness publications suggest, an electromyographical analysis of four abdominal exercises demonstrated that one exercise would train the rectus abdominis as well as another.
  - a. True
  - b. False
  
3. In the corporate setting, athletic trainers are:
  - a. finding that most corporate rehab/fitness programs are "elitist" perks.
  - b. proving that proper and prompt "in-house" rehabilitation saves the employer money.
  - c. increasingly playing a role.
  - d. finding that the majority of corporate managers are aware and supportive of the option of athletic trainers and their role in cost reduction.
  - e. b and c
  
4. In general, varsity athletes have much lower rates of drug/alcohol use than the general college population.
  - a. True
  - b. False
  
5. Characteristics of an ideal prophylactic knee brace include:
  - a. no increased risk of injury elsewhere in the lower extremities.
  - b. nonadaptability to various anatomical shapes and sizes.
  - c. documented efficacy in preventing injuries.
  - d. a and c
  - e. All of the above.
  
6. When dealing with the problem of alcohol and other drugs,
  - a. the athletic trainer is usually the one responsible for implementing alcohol and other drug (AOD) programs.
  - b. education is the best defense.
  - c. treatment and sanctions are mildly important.
  - d. All of the above.
  - e. a and b only.
  
7. Primary Care Sports Medicine:
  - a. can include any orthopaedic branch of medicine.
  - b. is a term synonymous with "generalist."
  - c. most commonly includes specialists in family practice, pediatrics, internal medicine, and emergency medicine.
  - d. All of the above.
  - e. None of the above.
  
8. An attempt to determine if lateral prophylactic knee braces were effective at stabilizing remedial collateral ligaments against valgus loading to the knee joint showed:
  - a. all three knee braces were effective at stabilizing the knee joint from a static valgus force.
  - b. the McDavid Knee Guard was more effective than the Anderson Knee Stabler-101W.
  - c. the Don Joy-PKG was less effective than the other two.
  - d. All of the above.
  - e. None of the above.
  
9. A rigid lumbar/sacral support:
  - a. affects trunk extension movements.
  - b. decreases strength during movement tasks involving trunk flexion with resistance.
  - c. does not decrease strength during movement tasks involving trunk flexion with resistance.
  - d. does not affect trunk extension movements.
  - e. b and d
  
10. Electromyographic analysis of four abdominal exercises demonstrated that:
  - a. specific abdominal exercises will develop specific quadrants of the rectus abdominis.
  - b. a regimen to increase the strength of the rectus abdominis should include several abdominal exercises.
  - c. the standardized muscle activity in each quadrant was not significantly different, regardless of the exercise.
  - d. All of the above.
  - e. None of the above.
  
11. Some advantages of an "in-house" corporate rehabilitation center might include:
  - a. a tendency by employees to be more diligent with use of the services provided.
  - b. the athletic trainer has a "first-hand" knowledge of the company's culture.
  - c. a greater potential to ensure coordination, continuity, and availability of services.
  - d. All of the above.
  - e. b and c only.
  
12. Attitudes about mandatory drug education and testing indicate that:
  - a. females want more equality in testing; males do not.
  - b. coaches and trainers should be tested too.
  - c. drug testing does not discourage use.
  - d. it is considered an invasion of privacy by almost all athletes.
  - e. All of the above.
  
13. Effective drug education programs include:
  - a. the "shotgun" approach.
  - b. those in which athletes have a sense of ownership.
  - c. "broad brush" programs.
  - d. All of the above.
  - e. None of the above.
  
14. Any physician can independently declare himself/herself a Sports Medicine Specialist.
  - a. True
  - b. False
  
15. Obtaining a medical golf cart for use by the high school athletic trainer:
  - a. can be accomplished with some ingenuity.
  - b. could be a combined effort of the athletic trainer, the sports booster club, some thought-after donations, and the local vocational auto body shop.
  - c. would cost well over \$350.
  - d. All of the above.
  - e. a and b only.

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*\*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.

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# B ook Review

by Phil Callicutt, EdD, ATC

## ***Introduction to Nutrition, Exercise and Health***

Editors: Frank I. Katch, PhD, and William D. McArdle, PhD  
Lea and Febiger, Malvern, Pa  
1993  
4th edition  
245 pages, illustrated  
Price: \$39.50 (\$48.50 with workbook)

Recently, Lea and Febiger announced the publication of **Introduction to Nutrition, Exercise and Health**, 4th edition, by Frank I. Katch, PhD, Professor of the Department of Exercise Science at the University of Massachusetts, Amherst, and William D. McArdle, PhD, of the Department of Health and Physical Education at Queens College, City University of New York at Flushing. The fourth edition is a continuation of the popular text which is used widely in colleges and universities across the country.

The explosion of new information in the last 5 years of the interrelated and protective role of both nutrition and physical activity in many disease processes, including coronary heart disease, cancer, osteoporosis, and obesity, has refocused the authors' attention on course content. To this end, Dr. Katch and Dr. McArdle broadened the original textbook, starting with a new title, **In-**

**roduction to Nutrition, Exercise and Health**. The term "health" in the title is added because coverage in the area is more robust, and the relationship between exercise and nutrition and health is more direct than in the past editions.

The text is divided into 20 chapters and 7 appendices. Examples include chapters on: exercise, nutrition, and osteoporosis; basic nutrition and cancer; physical activity and coronary heart disease prevention; primary and secondary risk factors and their relationship to both diet and exercise; physical activity and pregnancy outcome; and clear interrelationships among nutrition, weight control, and exercise.

There are new chapters on food advertising, food packaging, and food labeling, and separate chapters devoted to carbohydrates, lipids, proteins, vitamins, minerals, and water. Another outstanding attribute of this text is the clear, concise, and detailed nature of the photographs, illustrations, and charts. I would be hard-pressed to recall better quality and use of photographs, illustrations, and charts than those in **Introduction to Nutrition, Exercise and Health**.

An additional attraction is a workbook/study guide which contains information on fitness tests, dietary recall, expense calories, body composi-

tion, flex exercises, and self-administered labs.

The authors have given us an outstanding text that has a little something for all sports medicine professionals who have a desire to increase their level of knowledge in the ever-growing discipline of nutrition, exercise, and health. I strongly recommend this text for everyone. It is well-written and illustrated, and well worth the price.

## **NOTE TO MY COLLEAGUES:**

It has been my pleasure for the last 9 years to express my views in the form of book reviews for the *Journal*. During this period, I have seen this publication grow into an internationally recognized allied medical publication under the leadership of C. Steven Yates and Kenneth Knight. Due to a recent promotion and increased managerial responsibilities with the Federal Law Enforcement Training Center (FLETC), I find it necessary to resign my position on the Editorial Board. I want to take this opportunity to thank all of the readers for their support during the last 9 years. I have appreciated the opportunity of serving on this prestigious publication and want to wish all of you and the *Journal* continued success for the future.

## THE ANKLE

- Amendola A. Controversies in diagnosis and management of syndesmosis injuries of the ankle. *Foot Ankle*. Jan 1992;13:44-50. Review article: 57 refs.
- Armstrong PF. Serious fractures and joint injuries involving the foot and ankle. *Instr Course Lect*. 1992;41:413-20. Review article: 27 refs.
- Berquist TH. Magnetic resonance imaging of the foot and ankle. *Semin Ultrasound CT MR*. Aug 1990;11:327-345. Review article: 66 refs.
- Biedert R. Dislocation of the tibialis posterior tendon. *Am J Sports Med*. Nov-Dec 1992;20:775-776.
- Biedert R. Anterior ankle pain in sports medicine: aetiology and indications for arthroscopy. *Arch Orthop Trauma Surg*. 1991;110:293-297.
- Blake RL, Lallas PJ, Ferguson H. The os trigonum syndrome. A literature review. *J Am Podiatr Med Assoc*. Mar 1992;82:154-161.
- Boruta PM, Bishop JO, Braly WG, Tullios HS. Acute lateral ankle ligament injuries: a literature review. *Foot Ankle*. Oct 1990;11:107-113. Review article: 80 refs.
- Boytim MJ, Fischer DA, Neumann L. Syndesmotic ankle sprains. *Am J Sports Med*. May-Jun 1991;19:294-298.
- Brand RL. Ligamentous injuries to the lateral aspect of the ankle: the ankle sprain. *J Med Assoc Ga*. Jun 1992;81:293-295. Review article: 7 refs.
- Broos PL, Bisschop AP. A new and easy classification system for ankle fractures. *Int Surg*. Oct-Dec 1992;77:309-312.
- Calandre EP, Ruiz-Morales M, Lopez-Gollonet JM, Hernandez MA, Guerrero JA, Rodenas E, Garcia-Sanz FL. Efficacy of oral streptokinase-streptodornase in the treatment of ankle sprains. *Clin Orthop*. Feb 1991;263:210-214.
- Calmels P, Escafit M, Domenach M, Minaire P. Posturographic evaluation of the proprioceptive effect of ankle orthoses in healthy volunteers. *Int Disabil Stud*. Apr-Jun 1991;13:42-45.
- Cardone BW, Erickson SJ, Den Hartog BD, Carrera GF. MRI of injury to the lateral collateral ligamentous complex of the ankle. *J Comput Assist Tomogr*. Jan-Feb 1993;17:102-107.
- Cawley PW, France EP. Biomechanics of the lateral ligaments of the ankle: an evaluation of the effects of axial load and single plane motions on ligament strain patterns. *Foot Ankle*. Oct 1991;12:92-99.
- Cetti R, Andersen I. Roentgenographic diagnoses of ruptured Achilles tendons. *Clin Orthop*. Jan 1993;286:215-221.
- Chee SG, Khoo TK, Chong BK, Tan KP. Early local experience of ankle arthrography and its influence on management of patients with ankle injury. *Singapore Med J*. Apr 1991;32:130-133.
- Chen DS, Wertheimer SJ. Centrally located osteochondral fracture of the talus. *J Foot Surg*. Mar-Apr 1992;31:134-140. Review article: 33 refs.
- Cornwall MW, Murrell P. Postural sway following inversion sprain of the ankle. *J Am Podiatr Med Assoc*. May 1991;81:243-247.
- Davis AW, Alexander IJ. Problematic fractures and dislocations in the foot and ankle of athletes. *Clin Sports Med*. Jan 1990;9:163-181. Review article: 38 refs.
- DeMaio M, Paine R, Drez D Jr. Chronic lateral ankle instability--inversion sprains: Part I. *Orthopedics*. Jan 1992;15:87-96.
- DeMaio M, Paine R, Drez D Jr. Chronic lateral ankle instability--inversion sprains: Part II. *Orthopedics*. Feb 1992;15:241-248. Review article: 116 refs.
- Diebschlag W, Nocker W, Bullingham R. A double-blind study of the efficacy of topical ketorolac tromethamine gel in the treatment of ankle sprain, in comparison to placebo and etofenamate. *J Clin Pharmacol*. Jan 1990;30:82-89.
- Eisele SA, Sammarco GJ. Fatigue fractures of the foot and ankle in the athlete. *J Bone Joint Surg Am*. Feb 1993;75:290-298. Review article: 35 refs.
- Ferkel RD, Flannigan BD, Elkins BS. Magnetic resonance imaging of the foot and ankle: correlation of normal anatomy with pathologic conditions. *Foot Ankle*. Apr 1991;11:289-305.
- Ferkel RD, Karzel RP, Del Pizzo W, Friedman MJ, Fischer SP. Arthroscopic treatment of anterolateral impingement of the ankle. *Am J Sports Med*. Sep-Oct 1991;19:440-446.
- Fields KB, Rasco T, Kramer JS, Cates R. Rehabilitation exercises for common sports injuries. *Am Fam Physician*. Mar 1992;45:1233-1243. Review article: 21 refs.
- Friedrich JM, Schnarkowski P, Rubenacker S, Wallner B. Ultrasonography of capsular morphology in normal and traumatic ankle joints. *JCU*. Mar-Apr 1993;21:179-187.
- Gillies R, Geary N. Unusual pronation dorsiflexion fractures of the ankle. *Injury*. 1992;23:353-354.
- Hergenroeder AC. Diagnosis and treatment of ankle sprains. A review. *Am J Dis Child*. Jul 1990;144:809-814. Review article: 24 refs.
- Jacobson KE, Liu SH. Anterolateral impingement of the ankle. *J Med Assoc Ga*. Jun 1992;81:297-299. Review article: 6 refs.
- Karlsson J, Andreasson GO. The effect of external ankle support in chronic lateral ankle joint instability. An electromyographic study. *Am J Sports Med*. May-Jun 1992;20:257-261.

Karlsson J, Lansinger O. Lateral instability of the ankle joint. *Clin Orthop*. Mar 1992;276:253-261.

Konradsen L, Hilmer P, Sundergaard L. Early mobilizing treatment for grade III ankle ligament injuries. *Foot Ankle*. Oct 1991;12:69-73.

Kuwada GT. Chronic ankle instability and pain: a case report of a teenager with open epiphysis. *J Foot Surg*. Sep-Oct 1992;31:504-508.

Linenger JM, Shwayhat AF. Epidemiology of podiatric injuries in US Marine recruits undergoing basic training. *J Am Podiatr Med Assoc*. May 1992;82:269-271.

Liou J, Totty WG. Magnetic resonance imaging of ankle injuries. *Top Magn*

*Reson Imaging*. Sep 1991;3:1-22. Review article: 54 refs.

Litt JC. The sprained ankle. Diagnosis and management of lateral ligament injuries. *Aust Fam Physician*. Apr 1992;21:447, 452-456. Review article: 27 refs.

Loomer R, Fisher C, Lloyd-Smith R, Sisler J, Cooney T. Osteochondral lesions of the talus. *Am J Sports Med*. Jan-Feb 1993;21:13-19.

Mayer DP, Jay RM, Schoenhaus H, Ruiz S. Magnetic resonance arthrography of the ankle. *J Foot Surg*. Nov-Dec 1992;31:584-587.

Merchan EC. Subtalar dislocations: long-term follow-up of 39 cases. *Injury*. 1992;23:97-100.

Michelson JD, Clarke HJ, Jinnah RH. The effect of loading on tibiotalar alignment in cadaver ankles. *Foot Ankle*. Apr 1990;10:280-284.

Milford PI, Dunleavy PJ. A pilot trial of treatment of acute inversion sprains to the ankle by ankle supports. *J R Nav Med Serv*. Summer 1990;76:97-100.

Milgrom C, Shlamkovitch N, Finestone A, Eldad A, Laor A, Danon YL, Lavie O, Wosk J, Simkin A. Risk factors for lateral ankle sprain: a prospective study among military recruits. *Foot Ankle*. Aug 1991;12:26-30.

Millea TP, Romanelli RR, Segal LS, Lynch CJ. Ipsilateral fracture-dislocation of the hip, knee, and ankle: case report. *J Trauma*. Mar 1991;31:416-419.

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- Miller EA, Hergenroeder AC. Prophylactic ankle bracing. *Pediatr Clin North Am*. Oct 1990;37:1175-1185. Review article: 20 refs.
- Moody ML, Koeneman J, Hettinger E, Karpman RR. The effects of fibular and talar displacement on joint contact areas about the ankle. *Orthop Rev*. Jun 1992;21:741-744.
- Mulherin WB. Treating injuries in tennis. *J Med Assoc Ga*. Jun 1992;81:317-321.
- Nyska M, Amir H, Porath A, Dekel S. Radiological assessment of a modified anterior drawer test of the ankle. *Foot Ankle*. Sep 1992;13:400-403.
- O'Hara J, Valle-Jones JC, Walsh H, O'Hara H, Davey NB, Hopkin-Richards H, Butcher RM. Controlled trial of an ankle support (Malleotrain) in acute ankle injuries. *Br J Sports Med*. Sept 1992;26:139-142.
- Perrin P, Perrin C, Courant P, Bene MC, Durupt D. Posture in basketball players. *Acta Otorhinolaryngol Belg*. 1991;45:341-347.
- Pope CF. Radiologic evaluation of tendon injuries. *Clin Sports Med*. Jul 1992;11:579-599. Review article: 23 refs.
- Raatikainen T, Putkonen M, Puranen J. Arthrography, clinical examination, and stress radiograph in the diagnosis of acute injury to the lateral ligaments of the ankle. *Am J Sports Med*. Jan-Feb 1992;20:2-6.
- Riddervold HO. Easily missed fractures. *Radiol Clin North Am*. Mar 1992;30:475-494. Review article: 13 refs.
- Risser WL. The acute management of minor soft tissue injuries. *Pediatr Ann*. Mar 1992;21:170-172. Review article: 8 refs.
- Ruda SC. Common ankle injuries in the athlete. *Nurs Clin North Am*. Mar 1991;26:167-180.
- Schmidt-Olsen S, Jorgensen U, Kaalund S, Sorensen J. Injuries among young soccer players. *Am J Sports Med*. May-Jun 1991;19:273-275.
- Shahabpour M, Handelberg F, Opdecam M, Osteaux M, Spruyt D, Vaes P, Verhaven E, Zygas P. Magnetic resonance imaging (MRI) of the ankle and hindfoot. *Acta Orthop Belg*. 1992;58(suppl 1):5-14.
- Shambaugh JP, Klein A, Herbert JH. Structural measures as predictors of injury in basketball players. *Med Sci Sports Exerc*. May 1991;23:522-527.
- Specchiulli F, Mastro Simone N, Laforgia R, Solarino GB. Acute lesions of the lateral ligaments of the ankle. Clinical and radiographic review. *Ital J Orthop Traumatol*. Jun 1991;17:261-268.
- Stanley KL. Ankle sprains are always more than 'just a sprain.' *Postgrad Med*. Jan 1991;89:251-255. Review article: 10 refs.
- Stiell IG, McKnight RD, Greenberg GH, Nair RC, McDowell I, Wallace GJ. Interobserver agreement in the examination of acute ankle injury patients. *Am J Emerg Med*. Jan 1992;10:14-17.
- Stiell IG, Greenberg GH, McKnight RD, Nair RC, McDowell I, Reardon M, Stewart JP, Maloney J. Decision rules for the use of radiography in acute ankle injuries. Refinement and prospective validation. *JAMA*. Mar 1993;269:1127-1132.
- Stiell IG, Greenberg GH, McKnight RD, Nair RC, McDowell I, Worthington JR. A study to develop clinical decision rules for the use of radiography in acute ankle injuries. *Ann Emerg Med*. Apr 1992;21:384-390.
- Taga I, Shino K, Inoue M, Nakata K, Maeda A. Articular cartilage lesions in ankles with lateral ligament injury. An arthroscopic study. *Am J Sports Med*. Jan-Feb 1993;21:120-126; discussion 126-127.
- Taylor DC, Englehardt DL, Bassett FH. Syndesmosis sprains of the ankle. The influence of heterotopic ossification. *Am J Sports Med*. Mar-Apr 1992;20:146-150.
- Tehrani Zadeh J, Kerr R, Amster J. Magnetic resonance imaging of tendon and ligament abnormalities: Part II. Pelvis and lower extremities. *Skeletal Radiol*. 1992;21:79-86.
- Tepelidis NT, Karstetter K. Management of acute trauma. *Clin Podiatr Med Surg*. Oct 1991;8:757-771. Review article: 25 refs.
- Thein R, Eichenblat M. Arthroscopic treatment of sports-related synovitis of the ankle. *Am J Sports Med*. Sep-Oct 1992;20:496-498.
- Trevino S, Baumhauer JF. Tendon injuries of the foot and ankle. *Clin Sports Med*. Oct 1992;11:727-739. Review article: 62 refs.
- Verhaven EF, Shahabpour M, Handelberg FW, Vaes PH, Opdecam PJ. The accuracy of three-dimensional magnetic resonance imaging in the diagnosis of ruptures of the lateral ligaments of the ankle. *Am J Sports Med*. Nov-Dec 1991;19:583-587.
- Wang LC, Love MB. Posteromedial dislocation of the ankle without fracture or diastasis. *Can Assoc Radiol J*. Feb 1993;44:55-56.
- Wilkerson LA. Ankle injuries in athletes. *Prim Care*. Jun 1992;19:377-392. Review article: 40 refs.
- Zwipp H, Hoffmann R, Thermann H, Wippermann BW. Rupture of the ankle ligaments. *Int Orthop*. 1991;15:245-249.
- Zwipp H, Schievink B. Primary orthotic treatment of ruptured ankle ligaments: a recommended procedure. *Prosthet Orthot Int*. Apr 1992;16:49-56.

# New Products

## Universal Sling Introduced

ärthron, inc has announced the availability of a multi-purpose, universal sling.

ärthron, based in Brentwood, Tenn, has developed a one-piece adaptation of the sling and swathe, called SlingWrap™. SlingWrap's design permits it to be used with equal efficacy for an assortment of injuries such as upper extremity fractures, shoulder and elbow



dislocations, clavicle fractures, and ac joint sprains.

Because of its construction, SlingWrap is universal in nature, resulting in no small, medium, large, or extra-large sizes to order or stock. Depending on the trainer's preference, SlingWrap can support and immobilize the arm off either shoulder.

Additional information is available by calling (800) 758-5633.

## Shoulder Stabilizer from JP

The JP Shoulder Stabilizer is designed to prevent excessive shoulder motion in football players with a history of anterior glenohumeral instability. This is achieved by limiting abduction,



forward flexion, horizontal abduction, and external rotation.

The stabilizer's design provides a variable balanced restriction of all motions without hindering needed movement. It is attached to the shoulder pads with one screw through the plastic chest plate and can be used for any offensive or defensive position.

The stabilizer will limit motion and prevent the athlete from moving into a position that might result in subluxation, but it is not represented to prevent anterior subluxation. The stabilizer is available in two sizes and can be used on either the right or left arm.

For additional information, contact JP Stabilizer, 1953 1st Avenue SE, Suite C-5, Cedar Rapids, IA 52403, or call (319) 362-6994.

## 3CI Offers Medical Waste Mail Kits

Houston-based 3CI Complete Compliance Corp, a medical waste management and disposal company, has received authorization from the US Postal Service to receive hypodermic needles, syringes, and other "sharps" waste materials through the mail for disposal.

According to 3CI, the Postal Service now requires that "sharps" be mailed in



approved containers that protect postal employees and customers from needles, other sharp objects, and leaking packages.

3CI's mail sharps system is designed for low-waste generators, which might include physicians, dentists, home health care workers, and individuals. The system tracks, incinerates, and documents the waste at a 3CI facility.

"We offer a closed loop process," said Dr. Burt Kunik, executive vice president of 3CI. "Most companies sell the product that collects the waste, but then arrange for it to be incinerated at someone else's facility. 3CI's ability to offer complete compliance gives clients the assurance they need when dealing with a waste that has liability attached to it."

For additional information, contact 3CI Complete Compliance Corporation, San Felipe Plaza, Suite 900, Houston, TX 77057, or call (713) 783-8200.

## Henley Intros Electrical Stimulator

Henley International, Inc of Sugar Land, TX, has introduced TEAM-MC™, a computerized, independent four-channel electrical stimulator.

TEAM (Tannenbaum Electro-Analgesia Method) is the first biologically designed wave form intended to block acute or chronic pain, according to the company. The TEAM-MC clinical unit delivers the patented Tannenbaum



milliamperage wave, plus the microcurrent wave form.

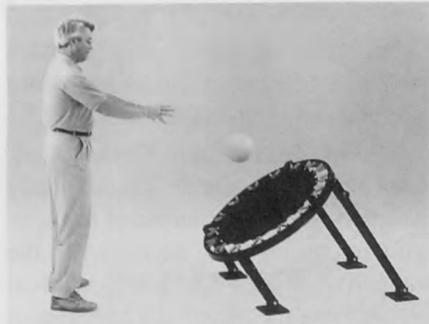
Each channel is capable of delivering either type of output in a preprogrammable fashion. Computerization enables any single- or double-phase combination of current, frequency, polarity, wave slope, and treatment time to be programmed into the TEAM-MC unit.

Favored clinician protocols are stored in 91 available memory slots and recalled. Patient parameters are set, stored, and recalled, including preset amplitudes with a built-in, 5-second ramp-to-peak output onset. Channel conductance is monitored and displayed continuously, along with treatment time remaining, on the high-resolution liquid crystal display monitor.

For more information, contact the customer service line at Henley International, (800) 477-7342.

## Total Gym Produces Rebounder

Total Gym/EFI Medical Systems has introduced the new Plyometric Rebounder. Designed to provide consistent upper body plyometric training, the rebounder's levels range from slow response to quick heavy response with



controlled power training in a variety of motions.

The Plyometric Rebounder provides stabilization in safe and functional positions for the spine, trunk, and extremities, while offering dynamic rhythmic stabilization of the joint in training. Patients experience a sense of self-sufficiency, while building muscle strength, elasticity, and improving neuromuscular control, according to the company.

Performing partner-type exercises alone allows the patient a heightened work period-controlled proprioceptive training, where joint position can be monitored strategically, while still freeing the therapist for more effective time management.

The Plyometric Rebounder has been designed to eliminate the bulkiness characteristics of systems having ballast for stabilization. It has been engineered to direct the incoming force into the ground.

The Plyometric Rebounder Package includes the Rebounder, a Ball Storage Rack, and five Weighed Therapy Balls of 2,4,8,12, and 20 pounds.

For more information, contact EFI/Total Gym Medical Systems, 9225 Dowdy Drive, Suite 221, San Diego, CA 92126, or call (800) 541-4900.

## Rich-Mar Designs Probe 100

Rich-Mar's Probe 100 has been designed to be used exclusively with Rich-Mar High Volt and Biphasic stimulators.

The Probe 100 locates areas of decreased skin resistance to then treat for relaxation of muscle spasms,



prevention or delay of muscle atrophy, increase of local blood circulation, muscle re-education, trigger-point therapy, and increase of ROM.

The location of these points is accomplished by finding areas of decreased skin resistance to low-volt current in an area that is related anatomically or physiologically to the source of the pain. These areas are indicated by visual and audible signal from the Probe 100. Treatment of the area can be completed with either the Probe 100 in the Treat mode or electrodes.

For more information, contact Rich-Mar Corporation, PO Box 879, Inola, OK 74036, or call (800) 762-4665.

## Zila Offers New Anesthetic Gel

DermaFlex™ topical anesthetic gel coating is available from Zila Pharmaceuticals. DermaFlex dries quickly on the skin to form a flexible, clear film coating that relieves pain, soothes itch-



ing, and protects the wound, even under water.

DermaFlex contains the topical anesthetic lidocaine. A thin coat of DermaFlex holds the lidocaine in place and seals out dirt, bacteria, and irritants. The DermaFlex coating conforms to the contour of the skin, protecting the wound through a range of activities, including sports and bathing.

Nonprescription DermaFlex is available at drug stores and supermarkets nationwide. Call (800) 922-7887 for a store near you.

## A

## Authors Guide

(Revised February 1992)

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

#### SUBMISSION POLICIES

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

#### STYLE POLICIES

7. The active voice is preferred. Use the third person for describing what happened. "I" or "we" (if more than one author) for describing what you did, and "you" or the imperative for instruction.
8. Each page must be typewritten on one side of 8½ X 11 inch plain paper, double spaced, with one-inch margins. **Do not right justify pages.**
9. Manuscripts should contain the following, organized in the order listed below, with each section beginning on a separate page:
  - a. Title page
  - b. Acknowledgements
  - c. Abstract and Key Words (first numbered page)
  - d. Text (body of manuscript)
  - e. References
  - f. Tables—each on a separate page
  - g. Legends to illustrations
  - h. Illustrations
10. Begin numbering the pages of your manuscript with the abstract page as #1; then, consecutively number all successive pages.
11. Titles should be brief within descriptive limits (a 16-word maximum is recommended). The name of the

disability treated should be included in the title if it is the relevant factor; if the technique or type of treatment used is the principle reason for the report, it should be in the title. Often both should appear.

12. The title page should 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.
15. Begin the text of the manuscript with an introductory paragraph or two in which the purpose or hypothesis of the article is clearly developed and stated. Tell why the study needed to be done or the article written, and culminate with a statement of the problem (or controversy). Highlights of the most prominent works of others as related to your subject are often appropriate for the introduction, but a detailed review of the literature should be reserved for the discussion section. In the one to two paragraph review of the literature, identify and develop the magnitude and significance of the controversy, pointing out differences between other's 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 return to competition, and deviation from the expected (what makes this case unique).

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

- d. The body of a **technique article** should include both the *how* and *why* of the technique; a step-by-step explanation of how to perform the technique, supplemented by photographs or illustrations; and why the technique should be used. The discussion of *why* should review similar techniques, point out how the new technique differs, and explain the advantages and disadvantages of the technique in comparison to the other techniques.
  - e. A **tip from the field** is similar to a technique article but much shorter. The tip should be presented and its significance briefly discussed and related to other similar techniques.
17. The manuscript should not have a separate summary section—the abstract serves as a summary. It is appropriate, however, to tie the article together with a summary paragraph or list of conclusions at the end of the discussion section.
  18. Citations in the text of the manuscript take the form of a 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 and in alphabetical order, and should be in the following form: a) articles: author(s) (list all) with the family names then initials, title of article, journal title with abbreviations as per *Index Medicus* (italicized or underlined), volume, year, inclusive pages; b) books: author(s), title of book (underlined), city and state of publication, publisher, year, inclusive pages of citation. Examples of references to a journal, book, and presentation at a meeting are illustrated below. See the *AMA Manual of Style* for other examples.
    - a. Knight K. Tips for scientific/medical writers. *Athletic Training, JNATA*. 1990; 25:47-50.
    - b. Day RA. *How to Write and Publish a Scientific Paper*. 3rd Ed. Phoenix, Ariz: Oryx Press; 1988:54-55.
    - c. Albohm M. Common injuries in women's volleyball. In: Scriber K, Burke EJ, eds. *Relevant Topics in Athletic Training*. Ithaca NY: Movement Publications; 1978:79-81.
    - d. Behnke R. Licensure for athletic trainers: problems and solutions. Presented at the 29th Annual Meeting and Clinical Symposium of the National Athletic Trainers' Association; June 15, 1978; Las Vegas, Nev.
  20. Tables must be typed. Type legends to illustrations on a separate page. See references cited in #5 or #19a for table formatting.
  21. Photographs should be glossy black and white prints. Graphs, charts, or figures should be of good quality and clearly presented on white paper with black ink in a form that will be legible if reduced for publication. 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.
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