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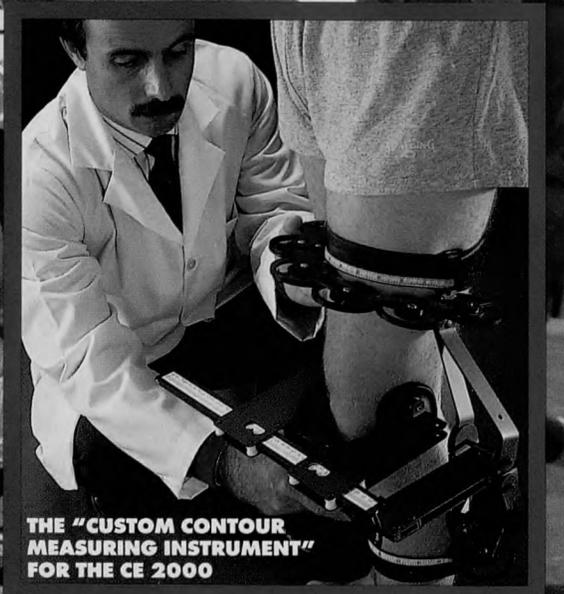
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Steve Yates, MEd, ATC
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Congratulations

Perseverance has certainly paid a great dividend as seen by the historic announcement of the American Medical Association and its Council on Medical Education recognizing athletic training as an allied health profession. Congratulations and thank you from all the NATA membership to those responsible for making this a reality.

More Congratulations

I would like to add my congratulations and thanks for a job well done to Margaret Webb, editor of the *NATA News*, for a most informative newsletter in September. As the *Journal* needs newsworthy items, I am sure the newsletter staff would also appreciate your input and articles of interest. The membership is urged to continue to submit material for publication.

Thanks

I would like to thank Debi Hilton of the *Journal* staff for her loyalty and dedication to *The Journal of the National Athletic Trainers' Association* for the past four years, and wish her much success for the future.

Closing

The holiday season is fast approaching and another year on the calendar will soon be but a memory. On behalf of the entire *Journal* Committee and staff, I wish each of you a joyous holiday season.

(SSSA)

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Editorial

Using First Person in Scientific Writing

Kenneth L. Knight, PhD, ATC

Our policy that articles are written with personal pronouns (I, we) and in the active voice has generated many questions among authors and potential authors. An explanation is in order. At one time, scientific, medical, and writing experts thought it was improper to use personal pronouns, and this forced authors to write in the passive voice. Most of us were taught this. But for the last 20 to 25 years, the experts have tried to change this policy (1-6). Unfortunately, the message is not getting through to many people, and these outdated thoughts persist.

In 1966, Tichy (6) wrote that the practice of not using personal pronouns was a common weakness in technical writing, but that there was "hope for the future." Her hope stemmed from the fact that writers and editors of many top scientific journals had begun employing "the active voice and personal pronouns without any loss of objectivity" (6).

Dr. Lois DeBakey, Professor of Scientific Communications at Baylor College of Medicine, wrote in 1968: "I strongly urge my students to abandon the current mode of scientific writing, which is generally dull, pompous, prolix, and rigid." (2). "Authors sometimes resort to the passive voice to avoid the presumed immodesty of the personal pronoun 'I.' In doing so, they often introduce ambiguity" (4). "The passive voice, of course, is appropriate in certain circumstances . . . Use of the passive voice, however, to avoid the personal pronouns 'I' and 'we,' or to evade a direct statement or identification of the opinion, is merely false modesty" (2).

Dr. Robert Day, Professor of English at the University of Delaware, and for 19 years the Managing Editor of the *Journal of Bacteriology* and eight other journals published by the American Society for Microbiology, agrees (1). He wrote in the classic *How to Write and Publish a Scientific Paper*: "Let us now talk about voice. In any type of writing, the active voice is usually more precise and less wordy than the passive voice . . . Why, then, do scientists insist on using the passive voice? Perhaps this bad habit is the result of the erroneous idea that it is somehow impolite to use first-person pronouns. As a result, the scientist typically uses such verbose (and im-

precise) statements as 'It was found that' in preference to the short, unambiguous 'I found.'"

"I herewith ask all young scientists to renounce the false modesty of previous generations of scientists. Do not be afraid to name the agent of the action in a sentence, even when it is 'I' or 'we.' Once you get into the habit of saying 'I found,' you will also find that you have a tendency to write '*S. aureus* produced lactate,' rather than, 'Lactate was produced by *S. aureus*.' (Note that the active statement is in three words; the passive requires five.)" (1).

In an *ELSE (European Life Science Editors)-Ciba Foundation Guide for Authors*, O'Connor and Woodford (5) wrote: "Use 'I' or 'we' for describing what you did, 'you' or the imperative for instructions, and the third person for describing what happened . . . Prefer the active voice ('I removed the needle') to the passive ('the needle was removed')." (5).

Let's not live in the past. The active voice and personal pronouns, when needed, will make your writing bold, simple, and concise. I urge you to adopt this policy when writing, not just for *Athletic Training*, *JNATA*, but in all your writing.

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Podiatric Examination Techniques For In-The-Field Assessments

Phil Hossler, MS, ATC
Paul Maffei, DPM

ABSTRACT: The channels of communication between the athletic trainer and other medical professionals must be not only two way, but must also exist on a common level so as to avoid misinterpretation. Through the use of the examination techniques explained in this article, the athletic trainer and the podiatrist can establish avenues of communication which will provide more comprehensive care for injured athletes. By using a format of reporting findings, such as the one included, the athletic trainer will serve as the triage professional who directs athletes toward the appropriate professional with an eye on early injury recognition, prevention, and proper treatment.

Athletic trainers, through daily contact with athletes, are able to recognize and often arrest medical problems before athletic participation is significantly affected. A portion of this recognition must be the exploration of posture and foot maladjustments which are within the athletic trainer's expertise. The communication of these findings to a podiatrist will result in quality care and reduced delay in treatment, as well as a mutual appreciation and respect of each profession's contributions and their interrelationships.

The foot-ankle area is an architectural wonder. The foot, an intricate arrangement of 26 bones, supported by muscles, ligaments, and tendons, can support hundreds of pounds of body weight. It can tolerate running long distances although each step produces two to seven times the normal body weight. At the same time, it can be expressive and delicate, and can also be used to participate in total body control.

The foot-ankle interface, if allowed to remain slightly out

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of symmetry, can, over a period of time, produce pain in the hips, knees, ankles, lower back, shoulders, or neck.

Recognition of functional discomfort, e.g., shin splints, "achy" knees, will allow the athletic trainer to assist in the prevention of positional deviations by the athlete. The athletic trainer must determine if the athlete is biomechanically predisposed to an **acute** injury (such as hyper-pronated feet, which can produce an eversion sprain in sports such as basketball), a **chronic** injury caused by repeated low grade trauma (such as running the same distance for six months before injury), or an **overuse** injury caused by changing an exercise routine too quickly.

The ability to identify minor aggravations before they escalate into disabling problems is of paramount importance to an athletic training program. Through the cooperative efforts of the coach, athlete, athletic trainer, general practitioner, and podiatrist with interests and backgrounds in athletic activity, many minor ailments can be relieved before they become a source of pain and impaired performance.

The following descriptions of examination techniques require the use of a flexible tape measure and a small or medium sized goniometer.

SCOLIOSIS SCREENING

Athletic trainers should be familiar with the relationship between the functioning of the ankle-foot and the resultant compensations in the upper body. They should be able to perform a variety of visual assessments in order to develop a complete picture of the posture of the athlete.

Evaluation Techniques

Visually assess the athlete for compensatory scoliosis by viewing from the front to assess bilateral levelness of the acromioclavicular prominences.

Place one thumb on each of the athlete's anterior superior iliac spines to visually estimate levelness of the pelvis.

View the athlete from the back to compare the medial inferior scapular angles for levelness.

View the popliteal folds in the posterior knees for levelness.

Place the palms of each hand in a horizontal plane on the iliac crests to estimate the level of the crests of the hips.

Instruct the athlete to place the palms of the hands together as if diving into the water. By flexing forward at the waist, both facing and turned away from the athletic trainer, the examiner is able to visually and digitally assess straightness of the spine.

Question the athlete as to whether or not one side of his/her gym or running shorts rides higher than the other. Does the athlete have to hem one pant leg or one side of a skirt higher than the other? If the athlete answers "yes" to these questions, this might indicate a lack of symmetry due to leg-length discrepancy, lack of pelvic levelness, or scoliosis.

LEG-LENGTH DISCREPANCY

A thorough history of the athlete's complaints is useful in assisting the athletic trainer to determine the source of the athlete's complaints. In the case of leg lengths, there are two types of leg-length discrepancies: true and apparent. With the use of the tape measure, the examiner can measure the athlete's leg lengths to assess an actual structural difference (true leg-length discrepancy) or determine whether there may be a pelvic obliquity (apparent leg-length discrepancy) as shown in uneven anterior superior iliac spine (ASIS) levels.

Evaluation Techniques

With the athlete lying supine (Figure 1), measure the distance from the ASIS to the apex of the medial femoral condyle.

Measure from the same spot on the medial condyle to the apex of the medial malleolus (Figure 2). Compare the measurements from one leg with the other leg. It is useful to mark the bony prominences with a pen and repeat the measurements to ensure proficiency and reliability.

To ensure that the athlete is not lying in an asymmetrical, yet comfortable position, instruct the person to lift the



Figure 1. Leg-length measurement from ASIS to medial femoral condyle to assess femoral shaft length

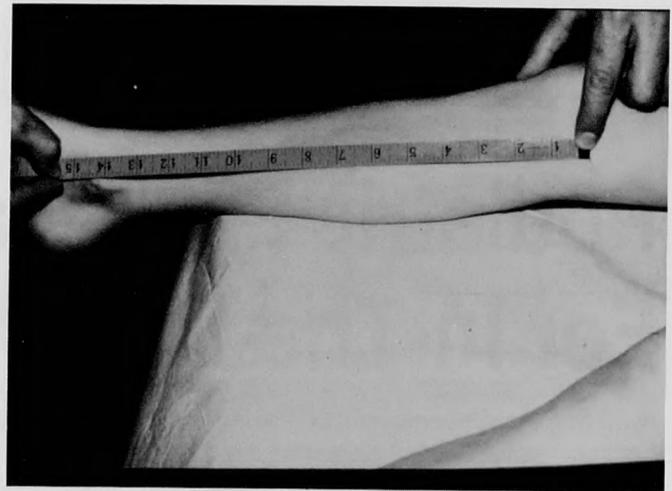


Figure 2. Leg-length measurement from medial femoral condyle to medial malleolus to assess tibial length

buttocks off the table by pressing down with the feet and upper back. This arching will allow the athlete to return to the table surface with the pelvis in a more structurally natural position.

To check the results obtained, look at the athlete both standing and walking. The shorter leg may demonstrate supination, while the longer leg may demonstrate pronation.

A quick method of checking the measurements is to position the athlete supine with the legs bent 90 degrees at the knees, both feet flat, and toes on the table. If there is a tibial length discrepancy, one knee will be higher when viewed from the front. If there is a femoral length discrepancy, one knee will project forward more than the other knee when viewed from the side.

Q ANGLE

Apparent problems which manifest themselves at the knee, e.g., chondromalacia and patellar tendonitis, are often the result rather than the cause of problems at another location. An indication of the stresses which are occurring at the knee may be the failure of the patella to track properly between the femoral condyles. The reason may be the manner in which the athlete's feet react upon weightbearing. If the foot is unstable, the athlete may produce excessive compensatory rotation at the knee joint. This, coupled with a lack of strength of the vastus medialis muscle, may be sufficient to prevent the patella from tracking properly.

The underside of the patella should be smooth and free from loose bodies. If the angle of the pull of the quadriceps is such that the patella does not slide smoothly between the femoral condyles, conditions such as chondromalacia or "runner's knee" may develop. An excessive Q angle (generally considered to be greater than 20 degrees) also contributes to an unstable extensor mechanism (2).

Evaluation Techniques

A bilateral assessment of quadriceps/hamstring strength and thigh girth measurements should be done to determine possible inequalities.

The Q angle is measured by placing one arm of the goniometer over the bisection of the femoral shaft and the other arm over the bisection of the patellar tendon and tibial tuberosity. This measurement should be repeated in both the weightbearing and non-weightbearing positions (Figure 3).

Approximate values for males in weightbearing and non-weightbearing positions are 15 degrees and 10 degrees, respectively; for females the respective values are 20 degrees and 15 degrees. The difference in values is due to the wider pelvic girdle of the female which causes the femur to meet the tibia at a more acute angle.

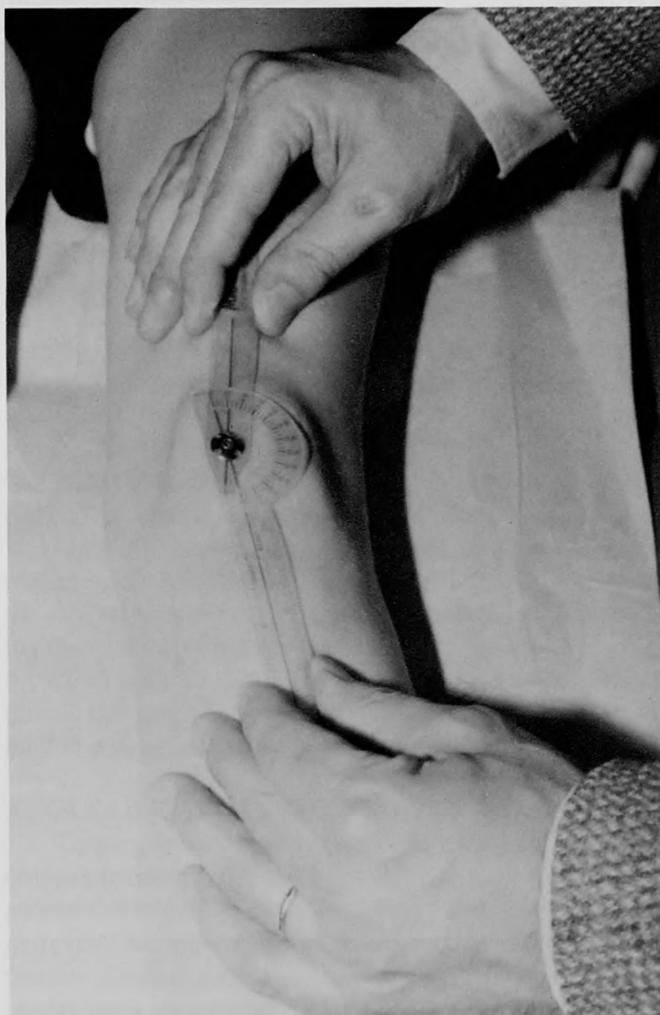


Figure 3. Q Angle assessment

ANKLE JOINT DORSIFLEXION

Sufficient limb and joint flexibility is necessary for any athletic event. Of greatest importance in the ankle is the subtalar joint (STJ), which has two-thirds of its motion toward inversion and one-third toward eversion. At the junction of this range of motion is the neutral angle or neutral foot.

Neutral position is achieved when the heel is perpendicular to the surface of the ground, and the arch is normal. The neutral foot is the ideal position since stability is derived from the neutral joints, meaning the muscles do not have to maintain the arch to support the body weight.

During running, it is essential that the lower leg be able to flex approximately 10 degrees past perpendicular to avoid forcing the entire foot-ankle-shin complex to pronate (internal rotation at the foot) in order to allow the athlete to run. A lack of flexibility resulting in dorsiflexion less than 10 degrees past perpendicular has been cited as a contributing cause to shin splints.

Evaluation Techniques

Position the athlete sitting on the table with the leg extended and the foot in the neutral position.

Place the thumb and forefinger of one hand on the anterior aspect of the shin on either side of the anterior distal malleoli. By moving the foot through slight eversion and inversion, you will, through practice, be able to assess the position at which the sub-talar joint is neutral.

Place one arm of the goniometer parallel to, or directly on, the shaft of the fibula, and hold it in place with the hand that is maintaining the neutral position of the STJ.

The other arm of the goniometer is placed on a line from the lateral aspect of the calcaneus bone to the base of the fifth metatarsal (Figure 4). Make certain that the line runs to the base of the fifth metatarsal, not the fifth phalangeal joint.



Figure 4. Ankle dorsiflexion measurement

Instruct the athlete to maintain the leg in full extension as you bring the foot into end range of dorsiflexion. Repeat with the knee flexed to approximately 90 degrees.

With an extended leg, there should be a minimum of 10 degrees of dorsal flexion; and with a flexed leg there should be a minimum of 20 degrees of dorsal flexion (4). If there is only a small increase in dorsal flexion with the knee bent, suspect a soft tissue restriction rather than a bony impediment. Such findings would indicate the need for heel cord and soleus stretching.

BLISTER FORMATION

The presence of blisters, calluses, and corns indicates friction, rubbing, and irritation. These may be due to a weightbearing imbalance of the foot, bony growth (exotosis), or excessive motion of the joints or bones.

If the calluses are found under bony prominence such as the metatarsal heads, they are usually the result of biomechanical dysfunction. Calluses on the heels are usually the result of an improper gait pattern, e.g., excessive pronation (5).

The basic cause of blisters should be examined so that the athlete can make the necessary adjustments, rather than casually assuming that blister formation is a necessary step in the process of conditioning. The repeated occurrence of a blister in the same location should not be overlooked.

Evaluation Techniques

A series of questions may help to discover the cause of blisters and calluses:

- 1) Is the athlete wearing new shoes?
- 2) If so, what steps were followed to break in the shoes prior to wearing them for practice or a game?
- 3) Do the shoes have a flexible forefoot with a firm heel counter? Stiff soled shoes may rub the foot excessively as it works to bend the sole prior to toe-off.
- 4) Do the shoes fit properly so that the ball of the foot is aligned under the "break" in the top of the shoe?
- 5) Would a lubricant alleviate the problem?

Blisters on the ball of the foot indicate excess motion (hypermobility), i.e., spinning prior to toe-off. Check to ensure that the shoes are not too large and that the laces are drawn snugly. Check for a wear bar across the width of the sole of the shoe underneath the ball of the foot.

If this blister and shoe wear pattern is chronic, the athlete should be referred to a podiatrist for gait analysis.

CALLUS FORMATION

The presence of calluses at both the first and fifth metatarsal heads indicates a supinated foot. A high arched foot and/or a foot which shows a notch on the sole between the second and third metatarsal may show callus formation on the heads of the first and fifth metatarsals. This occurs because the first metatarsal head drops down to reach the ground, but the second, third, and fourth heads do not, thus a notch is produced. This tight, supinated foot is a poor shock absorber. Orthotics may prevent this athlete from developing chronic arch strains and/or metatarsal stress fractures.

A compensated foot will have calluses on the second, third, and fourth metatarsal heads, indicating a pronated foot.

TOE FORMATIONS

The presence of mallet toe, hallux valgus (Figure 5), bunions, hammer toes (Figure 6), and depressed arches should alert the athletic trainer to the presence of a biomechanical abnormality that needs further examination. The athletic trainer can serve as the professional who is capable of recognizing sources of future problems. These structural abnormalities indicate an inefficient gait mechanism. For the benefit of future activity, as well as present athletic performance, the athlete should be referred to the appropriate specialist.



Figure 5. Hallux valgus may produce an inefficient gait mechanism.

SUBTALAR JOINT MOTION

Normal subtalar joint (STJ) motion produces two-thirds of the total movement in supination and one-third in pronation. Normal STJ inversion is approximately 20 degrees and normal eversion is approximately 10 degrees (4). To determine the neutral position between these two movements, use the following formula (4):

$$(Total\ Range\ of\ Motion/3) - Eversion\ Degrees = Neutral\ Position$$

Evaluation Techniques

Position the athlete prone on the examination table with both feet hanging over the end.

Using a pen or marker, place a mark (a) on the bisection of the Achilles tendon approximately four inches above its

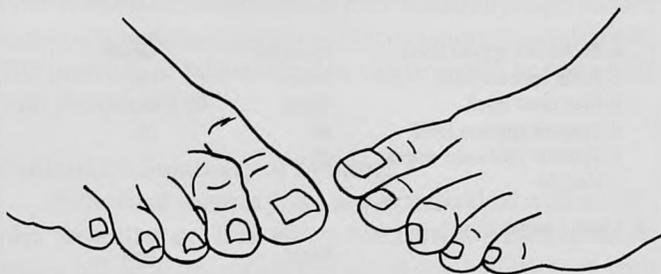


Figure 6. Toe contractures should alert the athletic trainer to possible biomechanical stresses which may lead to injury.

insertion, (b) at the apex of the curve on the Achilles tendon with the foot in supination (this is the location of the STJ), and (c) on the bisection of the calcaneal bone, making certain to avoid inclusion of fat pads (Figure 7).

Hold the center line of one arm of the goniometer on the mark at the bisection of the Achilles tendon.

Place the center line of the other arm on the mark indicating the bisection of the calcaneal bone.

Move the center of the goniometer over the mark indicating the location of the subtalar joint.

Hold both arms and the center in place as the foot is pushed into end range eversion and inversion. The degree of motion will be read directly on the center mark.

ANGLE OF GAIT AT THE MID-TARSAL JOINT

To complement the readings of subtalar joint motion in terms of rearfoot varus or valgus, it is advisable to assess the position of the athlete's forefoot during the stance phase of the gait cycle. A combination of findings such as restricted dorsal flexion coupled with excessive abduction would suggest results such as external tibial torsion or mid-tarsal joint pronation. These findings would necessitate care beyond what may have originally appeared to be adding simple arch pads or taping.

Evaluation Techniques

Instruct the athlete to step in place several times on a blank sheet of paper on either side of a line drawn to divide the body into the saggital plane.

Allow the athlete enough stationary steps until a normal feeling of walking and weight distribution is achieved.

When told to stop, the athlete should not attempt to correct or adjust the position of the feet or body.

Position one arm of the goniometer on the line drawn on the paper. Place the other arm of the goniometer, or draw a line, along the medial aspect of the foot (Figure 8). Normal



Figure 7. Subtalar joint motion produces two-thirds total movement in supination.

measurements will produce five to eight degrees of abduction (4).

This information should be coupled with the wear pattern of the athlete's shoes, presence of blisters, amount of supination-pronation, limb-length discrepancy, and any limitation



Figure 8. Assessment of the angle of gait at the mid-tarsal joint during the stance phase of the gait

of dorsal flexion to form a more complete picture of the biomechanics of the athlete's gait cycle.

SAMPLE ASSESSMENT

Figure 9 is a sample assessment with the athletic trainer's findings included. Ideally, this form will assist the podiatrist who, in turn, will add to the athletic trainer's findings.

Section 1. Scoliosis

Note that both the right shoulder and the right anterior superior iliac crest appeared lower than those on the left side, suggesting scoliosis. Usually with a limb length discrepancy, the longer side will be raised and the same side will be lower. The values present would suggest a positive finding of scoliosis.

Section 2. Limb Length

The measurements show a plus one inch in the left thigh segment and plus one-half inch in the right tibial segment producing a one-half inch difference in the left leg. This structural limb-length discrepancy might cause the left hip to be elevated.

Section 3. Q Angle

The Q angle values are high for both the right and left knees. Upon weightbearing, the Q angle will normally increase; however, this athlete's right knee increased from 20 to 30 degrees, while the left knee increased from 25 to 30 degrees. These values indicate the probability that the athlete's knees are affected by excessive pronation.

Section 4. Dorsal Flexion

The values of 10 degrees dorsiflexion with an extended right leg and 15 degrees with a flexed knee are within the normal limits. The values are low, however, suggesting a slight tightness of the soleus muscle. The degree of dorsiflexion in the left side is sufficient.

Section 5. Subtalar Joint Motion

The right side has 25 degrees of inversion and 15 degrees of eversion, for a total range of motion of 40 degrees. Following the formula—Total Range of Motion divided by three, minus the Eversion Measurement (40/3 - 15) equals the Neutral Position—the right side would be two degrees valgus (slight pronation) subtalar motion. On the left side, there were 25 degrees of inversion and 10 degrees of eversion for a total range of motion of 35 degrees. Placing these values in the equation produces a neutral position of one degree varus (slight supination).

Section 6. Angle of Gait

This athlete demonstrates 10 degrees abduction on the right side, and normal values on the left. This is suggestive of one of three conditions on the right side: 1) abduction in the hip joint or femur, 2) an external tibial torsion, or 3) the possibility of an increase in mid-tarsal joint pronation. The sophistication of this subtlety would require a referral to a sports podiatrist.

Podiatric Evaluation Summary		
1. Scoliosis	Right(ant/post)	Left(ant/post)
a. Shoulders appear level	lower/ok	ok/ok
b. ASIS appears level	lower/	ok/
c. Iliac crest level	ok/ok	ok/ok
d. Scapula appears level	ok	ok
e. Spinous processes appear straight	ok	
2. Limb Length	Right	Left
a. ASIS-Femoral Condyle	<u>19.25</u> inches	<u>20.25</u> inches
b. Femoral Condyle-Malleous	<u>15.25</u> inches	<u>14.75</u> inches
3. Q Angle	Right	Left
a. Non-Weightbearing	<u>20</u> degrees	<u>25</u> degrees
b. Weightbearing	<u>30</u> degrees	<u>30</u> degrees
c. Thigh Girth	<u>16</u> inches	<u>16</u> inches
4. Dorsal Flexion	Right	Left
a. Leg Extended	<u>10</u> degrees	<u>12</u> degrees
b. Leg Flexed	<u>15</u> degrees	<u>21</u> degrees
5. Subtalar Joint Motion	Right	Left
a. Inversion	<u>25</u> degrees	<u>25</u> degrees
b. Eversion	<u>15</u> degrees	<u>10</u> degrees
c. Total Range of Motion	<u>1</u> degree valgus/varus	<u>1</u> degree valgus/varus
6. Angle of Gait	Right	Left
(Abduction/adduction)	<u>10</u> degrees abd/add	<u>5</u> degrees abd/add
7. Soft Tissue and Structural Deformities		
a. Plantar Callous Formation		
Right - 1st <u>2nd</u> <u>3rd</u> <u>4th</u> 5th Heel Other _____		
Left - 1st <u>2nd</u> <u>3rd</u> <u>4th</u> 5th Heel Other _____		
b. Toe Contractures (Hammer Toes)		
Right - 1st <u>2nd</u> 3rd 4th 5th		
Left - 1st <u>2nd</u> 3rd 4th 5th		
c. Corns		
Right - 1st 2nd 3rd 4th 5th		
Left - 1st 2nd 3rd 4th 5th		
d. Hallux Valgus		
Right yes/no		
Left yes/no		
e. Blister Formation		
Right yes/no		
Left yes/no		
8. Miscellaneous		

Figure 9. Sample assessment

Section 7. Soft Tissue and Structural Deformities

The presence of bilateral calluses underneath the middle three metatarsal heads would suggest bilateral hyperpronation. Toe contractures (hammer toes) bilaterally of the second toes would again be suggestive of excessive pronatory changes. The presence of bilateral hallux valgus would be consistent with these findings.

Podiatrist's Summary of Findings

In the final summary, we see an individual with a complex presentation. This athlete has a positive mild scoliosis with a left-limb discrepancy of about one-half inch. A limb length discrepancy would complicate the identification of scoliosis. In addition, due to the high Q angle of both knees, this athlete is likely to be prone to chondromalacia of the patella on either leg, but particularly on the right.

Due to the sub-normal dorsal flexion, the athlete may or may not develop right-side problems due to the tightened structures. Stretching exercises for the hamstring and calf musculature would be appropriate for this athlete.

Assessing subtalar motion, we see that the athlete has a neutral or varus foot on the left and valgus foot on the right. This is most likely due to scoliosis forcing the right side down, even though the left side might be slightly longer, thus causing the excessive pronation. On the shorter side, we see a varus or neutral position.

The right side of the gait is abducted which complicates

evaluation because of the excessive pronation occurring either from a torsional problem or from an excessive pronation in the mid-tarsal joints.

The abnormal callus formation, toe contracture, and great toe deviations, would lead to the conclusion that these are all signs of chronic structural changes due to the excessive pronation.

This athlete would be predisposed to an acute injury or a series of chronic problems, and would be best served by referral to a sports podiatrist for biomechanical evaluation. The athlete may have a history of vague symptoms which seem to occur every season. This athlete would be a candidate for functional prescription orthotics in order to provide structural realignment to abate symptoms of chronic discomfort.

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**ANSWERS TO PREVIOUS
CEU CREDIT QUIZ
"Suing Athletic Trainers: Part I
A Review of the Case Law Involving Athletic Trainers"**

- | | | | |
|----|---|-----|---|
| 1. | d | 6. | c |
| 2. | b | 7. | b |
| 3. | b | 8. | a |
| 4. | c | 9. | b |
| 5. | d | 10. | b |

CEU Credit Quiz

PODIATRIC EXAMINATION TECHNIQUES FOR IN-THE-FIELD ASSESSMENTS

Phil Hossler, MS, ATC
Paul Maffei, DPM

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The NATA National Headquarters will be notified of all members with passing scores over 70%. CEU credit will be entered on each member's record at that time. Participation is confidential.

Questions

	a	b	c	d	e
1. The foot-ankle interface, if asymmetrical, can result in _____ pain. a. lower back b. neck c. shoulder d. all of the above e. none of the above					
2. To visually estimate the "levelness" of the pelvis, the evaluator can place a thumb on each _____. a. ASIS b. PSIS c. S ₂ "dimple" d. greater trochanter e. none of the above					
3. A "true leg-length discrepancy" is the same thing as an "apparent leg-length discrepancy." a. True b. False					
4. An <i>excessive Q angle</i> is generally described as greater than _____ degrees. a. 10 b. 15 c. 20 d. 25 e. none of the above					
5. At the subtalar joint, the relationship of the percentage of motion in inversion to the percentage of motion in eversion is _____. a. 1/4 total motion to 3/4 total motion b. 1/2 total motion to 1/2 total motion c. 2/3 total motion to 1/3 total motion d. 3/4 total motion to 1/4 total motion e. none of the above					
6. Which of the following has been identified as a contributory cause of shin splints? a. plantar flexion less than 10 degrees past perpendicular b. plantar flexion more than 10 degrees past perpendicular c. neutral position d. dorsiflexion less than 5 degrees past perpendicular e. dorsiflexion less than 10 degrees past perpendicular					

Questions

	a	b	c	d	e
7. The presence of calluses at both the first and fifth metatarsal heads indicates that the foot is _____. a. pronated b. supinated c. inverted d. everted e. none of the above					
8. Which of the following should suggest a biomechanical abnormality which requires further evaluation? a. bunions b. depressed arches c. hallux valgus d. all of the above e. none of the above					
9. At the subtalar joint, the percentage of movement of supination-to-pronation is the same as the percentage of motion of inversion-to-eversion. a. True b. False					
10. To complement the readings of the subtalar joint motion in terms of rearfoot varus or valgus, one could assess the forefoot position during the ____ phase of gait. a. toe-off b. swing c. stance d. all of the above e. none of the above					

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A Review of Record Keeping Sports Medicine Computer Software

Lanny Leroy, ATC, MEd

ABSTRACT: This paper describes two computer systems that are available for record keeping and reporting of sports injuries, Alfie and Integrated Injury Tracking System. These two systems contain field defaults, injury reporting, treatment records, and customized reporting functions. System requirements and compatibility also are described for each system. Database management systems are described as an alternative to Alfie and Integrated Injury Tracking System. The three systems are compared and contrasted using four criteria for selection of record keeping computer software.

It is not uncommon for hundreds of athletes to be treated in the traditional college training room in a given year. With so much to be done, many athletic trainers are beginning to use computers to keep records and manage treatment programs. Because few athletic trainers are also computer programmers, the task of choosing a computer and compatible software can be difficult.

Some training rooms use terminals connected to mainframe computers (1,6). If this arrangement meets athletic trainers' needs, it may be an easier and less expensive option; however, it is appealing to many athletic trainers to have a personal computer (PC) in their office. This avoids such problems as accessing mainframes or being unable to use them on holidays or weekends.

Once the decision has been made to purchase a PC for the training room, the task is to choose a system with compatible software. This decision is easier to make when athletic trainers become familiar with the available record keeping computer software packages.

Alfie and Integrated Injury Tracking System are two examples of software packages that utilize predefined data fields (field defaults). The athletic trainer simply chooses data for each field. A database management system allows the user to create any data field desired and place this data field where desired.

ALFIE

Alfie, which is distributed by Cramer Products, Inc., comes with five disks, each containing a different program.

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The five programs are Injury Reporting, Daily Treatment Log, Insurance Records, Physical Examination, and Medication Records (2). Any single program or combination of programs may be purchased.

General Characteristics

Alfie is available for either IBM or Apple computers, or compatible brands. If an IBM computer is used, 384 kilobytes (K) of Random Access Memory (RAM) are required; only 128K with an extended memory board are required for Apple and Apple-compatible computers. A two disk drive is recommended by Cramer; however, it is a simple procedure to copy Alfie onto a fixed (hard) disk, if the computer is already equipped with one. When purchasing computers and record keeping software packages, athletic trainers need to ask dealers if the computers have the necessary specifications such as adequate memory, and the number and types of drives to match the software packages. After accessing one of Alfie's programs, users simply follow the screen commands to operate the programs. Entering data into the Injury Reporting and Daily Treatment Log programs requires minimal typing because the two programs provide options which the user can select by moving the cursor.

Injury Reporting

Because this program uses field defaults, the data that is displayed depends on the information entered in a previous data field. For example, when filling out an injury report for a knee, Alfie will ask which specific structure in the knee, such as ACL or MCL, was injured. By moving the cursor, the user selects one of the specific structures displayed for entry in the "specific structure" data field. The specific structure list is different for the knee than for the shoulder, etc.. Figure 1 shows a sample injury report screen.

Daily Treatment Log

The Daily Treatment Log has many of the same functions as Injury Reporting. Before using the Daily Treatment Log, the athletic trainer must know which modalities are going to be used. This information is entered by users during the configuration stage (which is performed when accessing Alfie for the very first time) (2). Once the system is configured, the user selects one or more modalities for each record. The number of minutes that each modality is used can also be entered. Other data fields are: athlete's name, file number, sport, treatment date, injury date, and injury.

CRAMER SOFTWARE GROUP INJURY REPORT				
NAME: JONES, AL		CODE: 123-45-6789		DATE: 04-03-87
INJURY DATE: 03/20/87		SPORT: MBB	BODY AREA: LE	STRUCTURE: KNEE
SPEC. STRUC: TRIAD		SIDE: L	INJURY: MENISCUS TR.	MECH: DIR. CONT.
ONSET: A	CAUSE: C-P	SEVERITY: 3	POSITION: GUARD	ACTIVITY: SCR
TIME: G	PLATOON: D	HOSPITAL: Y	DR: JONES	STATUS: OUT
LOST - PRACTICES: 12 GAMES: 3				
THE STRUCTURE OF 'KNEE' CONTAINS THE FOLLOWING SPECIFIC STRUCTURES:				
BURSA, GENERAL	JOINT CAPSULE	LATERAL MENISCUS	MCL & MM	
INFRAPATELLAR BURSA	GENERAL LIGAMENT	MEDIAL MENISCUS	LCL & MEN	
PES ANSERINE BURSA	ANTERIOR CRUCIATE	PES ANSERINE MUSC	ACL & MCL	
PRE-PATELLAR BURSA	POSTERIOR CRUCIATE	SYNOVIAL MEMBRANE	ACL & LCL	
SUB-PATELLAR BURSA	MEDIAL COLLATERAL	MUSCULATURE, OTHER	• TRIAD	
SUPRAPATELLAR BURSA	LATERAL COLLATERAL	NERVE	GEN KNEE	

Figure 1. Alfie Injury Report screen displaying field defaults for the specific structures of the knee. Reprinted from Alfie Injury Management Software System with permission of Cramer Software Group, Cramer Products, Inc.

To generate a customized treatment report, Alfie can search for items in any data field. An example of this is a treatment record that contains a list of athletes who reported for treatment during any time period. The entire treatment record (all data fields) can also be printed. It includes such fields as injury, time of treatment, and duration of treatment. Alfie will also provide a Modality Usage Descriptive Statistical Report (2). This report includes total usage and duration of each modality, percentage of use for each modality, and treatment frequency and duration according to sport.

Customized Reports

The ability to generate customized injury reports is essential because athletic trainers must provide these reports to many different coaches. Alfie offers several reporting functions, one of which is an injury listing. This enables the user to search according to one or more fields in which data has been entered (2). When the injury reports are located, the complete injury report for all athletes who match the specified data is displayed. For example, if athletic trainers want to know how many football players had knee sprains, their only requirement is to "delimit" the three data fields of sport, injury, and structure. When this is accomplished, a complete injury report for all athletes who meet the criteria is displayed. The complete injury report will include data fields such as injured side, specific structure, and athlete's position.

The Injury Summary is another reporting function. For this report, Alfie reads all of the injury reports and gives the total number and mean (X) of each data field. The Daily Injury Report gives athletic trainers a list of all the athletes

whose names have been entered, except those who are listed as "full go" in the status data field. The Athletic Directory will produce the name and record number for each injury report, along with the body part and date of injury.

INTEGRATED INJURY TRACKING SYSTEM

The Integrated Injury Tracking System (IITS) was developed and is distributed by Micro Integration Services, Inc. (MIS). This program can be used for injury reporting, treatment reports, Cybex scoring, and rehabilitation reports (4). This system is more powerful and slightly more expensive than Alfie. The major difference is that the IITS can be used with its own commands or with dBase III Plus (4). This permits the data to be used on graphics packages or for custom reports using dBase III Plus.

General Characteristics

The IITS is available for IBM-compatible computers with a fixed (hard) disk and 640K of RAM. Two options are offered by MIS for an additional charge: a report generator, and one of several word processors that can be integrated into IITS in the Rehabilitation Section. Data is entered as if athletes had their own individual folders in a file cabinet. In other words, each injury report entered for an athlete will go into that individual's folder. To view or edit folders, the athletes' names or assigned code numbers must be entered. This displays the folders with all injuries sustained. Data is stored in codes; however, IITS will supply a list of codes and their meanings on the monitor.

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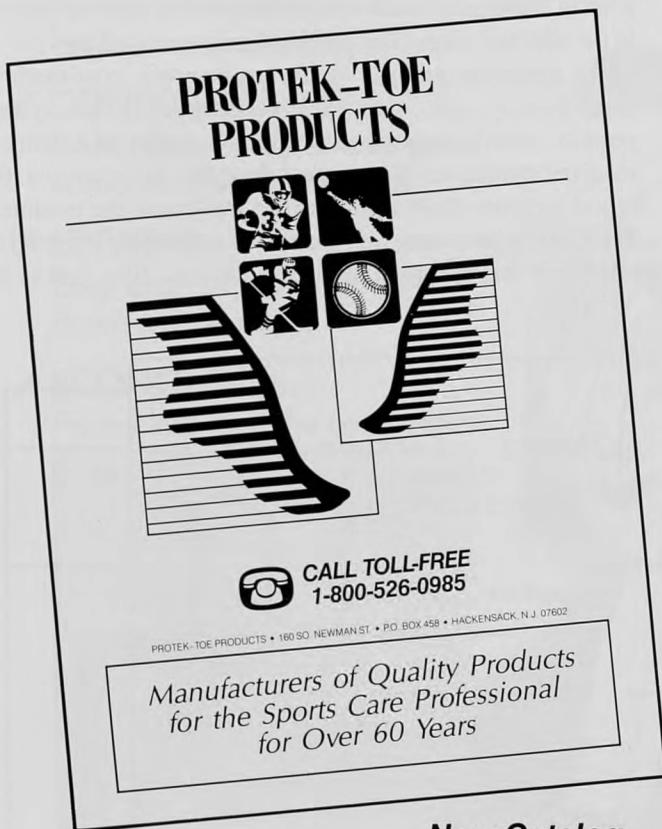


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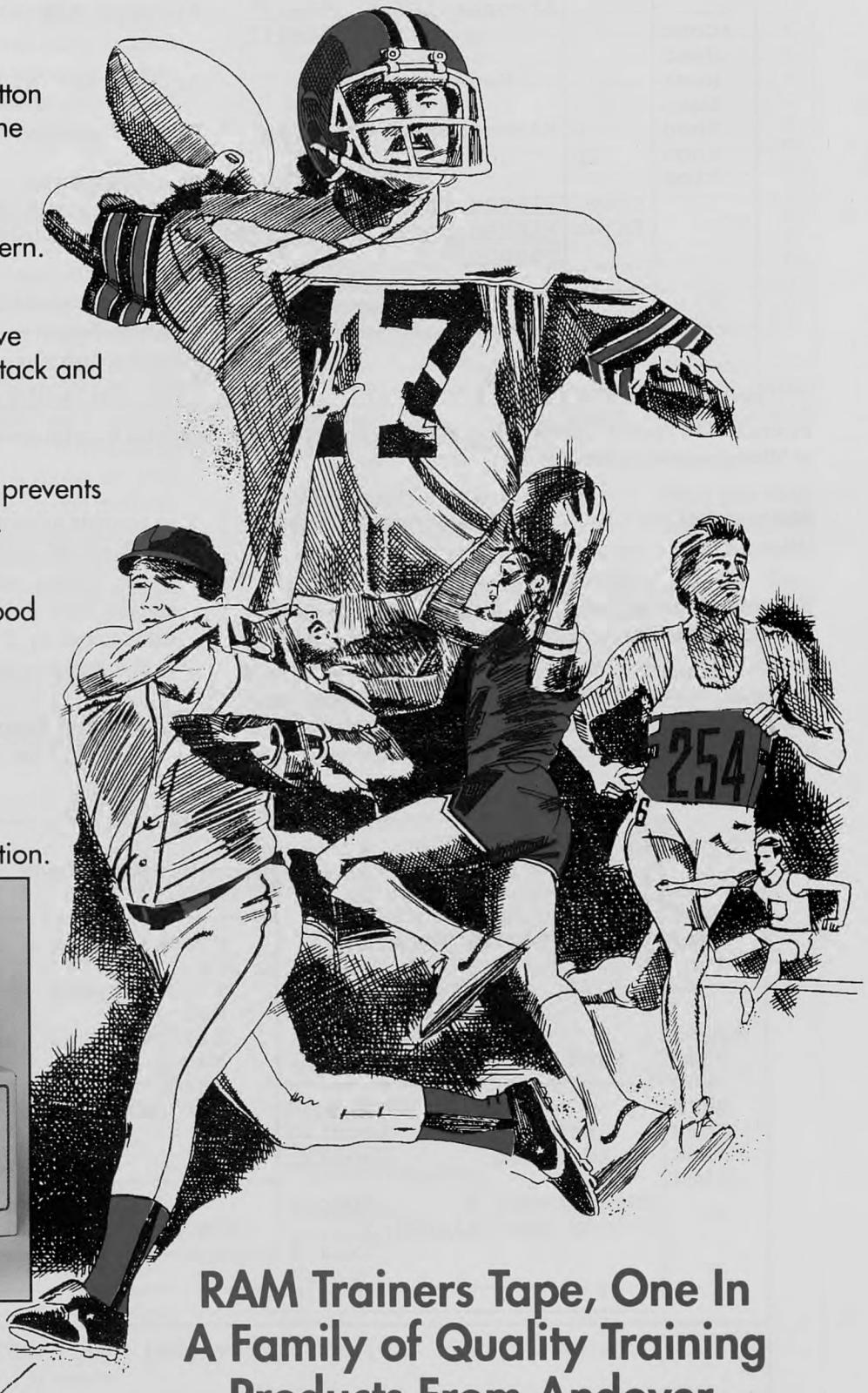
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		KNEE HISTORY				
		SPECIAL CONSIDERATIONS				
ID #	Date	R.O.M. <u>I</u>	Comment: <u>Knee locked at 20 deg</u>		ht R	
Pos.	Addit	Instability Type: <u>1</u> <u>3</u> <u>4</u> <u>6</u>				MI <u>W</u>
*Conc		Atrophy Left: <u>4"-19"</u>		Atrophy Right: <u>4"-18"</u>		
Head		<u>8"-24"</u>		<u>8"-23"</u>		
Neck		Recurrent: <u>N</u>		Arthogram: <u>N</u>		
Burn		Missed Practice: <u>48</u>		Missed Games: <u>10</u>		
Shou	D	Additional Knee Comments				
Shou	<u>10</u>	Player injured knee 4th game of regular season.				
Ribs	Knee	Placed on injured reserve for remainder of				
	Injur	<u>season.</u>				

Figure 3. IITS Special Considerations Window for knee injuries. Reprinted from Integrated Injury Tracking System with permission of Micro Integration Services, Inc.

data from the Cybex Testing, Injury Reporting, and Rehabilitation Sections is filed.

Rehabilitation Section

The Rehabilitation Section is unique. For a minimal charge, IITS can be connected to one of three word processing programs: Microsoft Word, PFS Write, or WordStar (4), to allow detailed notes to be written about the rehabilitation of athletes. The word processor can also be used alone in order

to generate memos or letters.

Since all data from the Injury Reporting, Treatment, Cybex Testing, and Rehabilitation Sections is stored in the athletes' files, the athletic trainer has quick access to all the data entered (4). There is no need to change programs, disks, or disk drives to access the data from the different sections.

Customized Reports

The IITS has six reporting functions: 1) print Athletes'

		INJURY CONDITIONS			
		Injury Time: <u>2</u>		Surface Conditions	
		Injury Season: <u>1</u>		[PgUp] This is Page 1 of 1 [PgDn]	
ID #		Inj During Game: <u>6</u>		Normal Icy Snow-Covered * Wet Slippery, not wet Muddy Hard Irregular 0 of 1 Selections Remaining <Space>-Select/Unselect <ESC>-Done	
Year		Inj During Pract: <u>-</u>			
Pos.		Inj Position Grp: <u>1</u>			
*Conc		Injury Situation: <u>5</u>			
Head		Surf. Condition: <u>8</u>			
Neck		Stadium: <u>3</u>			
Burn		Activity: <u>10</u>			
Shou		Surf. Condition: <u>4</u>			
Shou		Major S			
Ribs		Locatio			
	Dates	<u>10/36/86</u>			
		<u>Paoli,</u>			
	Knee Grade: <u>B</u>	Specia			
	Injury Conditions: <u>Y</u>	Exam F			
(A)dd (E)dit (N)ext (Previous) or <RETURN> to exit					

Figure 4. IITS Injury Conditions Window for knee injuries displaying field defaults for the Surface Conditions data field. Reprinted from Integrated Injury Tracking System with permission of Micro Integration Services, Inc.

Overall Grade, 2) print Complete Injury Report, 3) print Leg Strength Results, 4) print Injury Breakdown by Body Area, 5) print Treatment Report, and 6) extract Injury Information (4). Leg Strength Results and Treatment Reports are discussed under the Cybex Testing and Treatment Sections, respectively.

A report listing athletes by an overall grade provides their names and their corresponding rating (1-6) in descending order. The athletic trainers decide the overall rating for each athlete and enter these ratings in the injury reporting section. Printing complete injury reports for athletes produces all of the information in each data field for all injury reports entered for the requested athletes.

The IITS has the capability to produce the total number of injuries such as sprains, strains, and contusions for each of the 23 body areas. Figure 5 represents the total number of injuries for one body area. The Complete Injury Breakdown by Specific Body Area report includes all 23 body areas. The most flexible reporting function is the Extract Injury Information. This report is produced by selecting information from two data fields in any data window of the exam section. For example, in Figure 6, the data fields selected are knee ligament injuries and lateral meniscus injuries. The format can be printed in three different modes. The first shows the total injuries that match the requested data. The second produces the names of athletes that match the requested data, along with their injury type, date, and side, plus a total record count (see Figure 6). The third is a complete injury report for all athletes who match the requested data.

DATABASE MANAGEMENT SYSTEM (DBMS)

Database systems allow for the creation of any data fields felt to be appropriate, such as injury, specific structure, side,

DATE: 05/25/88 1987 INJURY BREAKDOWN IN P. 1
 NUMBERS OF SPECIFIC BODY AREA

(1) ANKLE INJURIES	
Contusion/Direct Impact	32
Hyperflexion	1
Hyperextension	1
Torsion-Twist	17
Strain I	1
Strain II	1
Strain III	0
Sprain I	4
Sprain II	34
Sprain III	0
Rupture	0
Subluxation	0
Dislocation	0
Chip Fracture	0
Fracture	0
Avulsion	0
Stress Fracture	0
Overuse Syndrome	0
Derangement	0

Figure 5. IITS Injury Breakdown for ankle injuries. Reprinted from Integrated Injury Tracking System with permission of Micro Integration Services, Inc.

body part, treatment, or time of day (5,7). These data fields can be of any size and positioned in any format on printouts (3).

DBMSs are available at most computer stores. Some examples are Microsoft File, dBase, dBase III Plus, R:Base, and PFS: File. Each is compatible with specific computers, so athletic trainers should consult with a reputable dealer before purchase. For example, Microsoft File is compatible with most Apple computers, and dBase III is compatible with

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EXTRACTION REPORT

<u>PLAYER NAME</u>	<u>INJURY DATE</u>	<u>INJURY TYPE(S)</u>	<u>L/R</u>
***** KNEE INJURIES *****			
PEOPLES, TIM	12/03/82	Contusion/Hematoma Strain II	L
TRAVERS, VINCE	11/27/85	Contusion/Hematoma	L
SERF, STEVE	04/11/84	Strain II Contusion/Hematoma	L
PRICE, DAVID W	10/28/86	Torsion-Twist Contusion/Hematoma	R
SMITH, GLENN C	07/17/87	Strain II Strain III Sprain I Sprain II	R
***** TOTAL KNEE INJURY COUNT = 21 *****			

Figure 6. IITS Extraction Report for knee ligaments and lateral meniscus injuries, an example of the second mode. Reprinted from Integrated Injury Tracking System with permission of Micro Integration Services, Inc.

most IBM computers. The prices will vary from system to system and from store to store.

The primary advantage offered by a DBMS is the ability to sort information and print only the data fields desired (3,5,7). When using Alfie and IITS, athletic trainers wishing to find athletes with knee injuries must access the athletes' complete injury records. With a DBMS, athletic trainers have the ability to decide which data fields are to be printed (3,5,7). For example, a customized report can be created that would include only the name of an injured athlete, the treatment, and/or the injury.

DISCUSSION

Each software system will be compared using the following four criteria: report formatting, data field defaults, technical support, and expandability (see Table 1). Report formatting is the ability of the software to allow users to select only specific data fields to be printed on a report. A DBMS is best for performing this function. This feature is found in most systems, although each brand may have this function under different commands. Also, IITS can perform this function if the user purchases the optional report generator. This is possible because IITS is compatible with dBase III Plus. Alfie does not provide this function.

Another important selection criterion is the ability of the software to present data field defaults. These are lists on the monitor from which users may choose information to be entered for data fields. Alfie and IITS provide this function. With Alfie, users operate cursor commands to enter the word or phrase. Users of IITS type numbers corresponding to words or phrases. The use of numbers makes data entry quicker, after users become familiar with the system. Numbers also require less storage space; however, the list of corresponding words or phrases must be displayed so that the numbers have meanings. Most DBMSs do not offer this feature.

The third criterion is technical support. DBMSs and IITSs are manufactured and distributed by companies that specialize in computer software. Because of this specialization, these two systems have the advantage of technical support. Cramer specializes in sports medicine products and has established a department especially for Alfie called the Cramer Software Group. It is responsible for both the selling and the technical support of Alfie. The degree of technical support is only as good as the accessibility of the appropriate department.

A final consideration is expandability. Because of the rapid developments in computers, any software system purchased must be able to expand with the technology. Newer DBMSs are able to integrate with such technology as word processors, graphics packages, tutorial programs, spreadsheet programs, and on-line help files. The record keeping software system that is purchased should be able to accommodate this technology as athletic trainers desire. As changes are made to Alfie and IITS, Cramer and MIS will offer free updates. Most DBMS manufacturers also provide this free service to purchasers.

TABLE 1. Summary of criteria for selection of software

	Alfie	IITS	DBMS
Report Formatting		X	X
Field Defaults	X	X	
Technical Support		X	X
Expandability			
Graphics		X	X
Word Processor		X	X
Spread Sheet			X
Ability to Skip Data Fields Without Entering Data		X	X
Confidentiality of Records		X	X
On-line Help			X
Tutorial Files			X
Speed of Data Entry	X	X	

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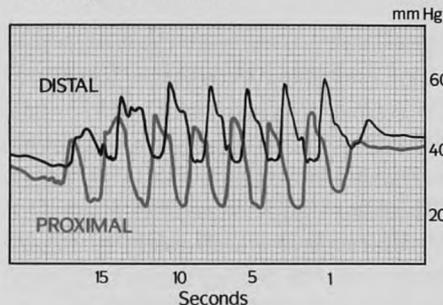
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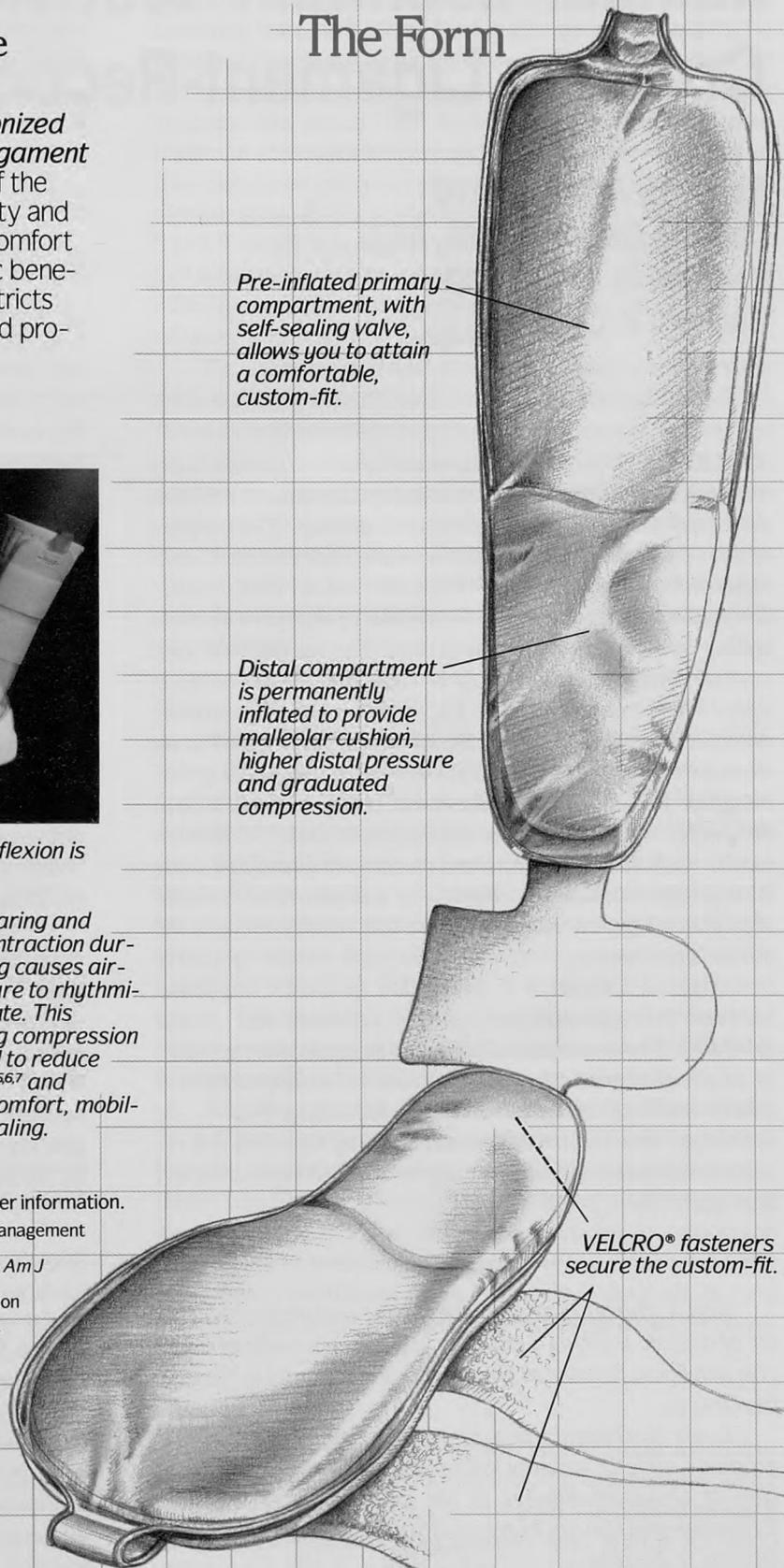
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A Comparison of Instrumented and Manual Lachman Test Results in Anterior Cruciate Ligament-Reconstructed Knees

Rod A. Harter, PhD, ATC

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Kenneth M. Singer, MD

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ABSTRACT: Objective measurement of knee ligament laxity has recently become more clinically prevalent due to the commercial availability of specific testing devices. The purpose of this study was to compare the results of instrumented Lachman testing employing a KT-1000 arthrometer (MEDmetric Corp., San Diego, CA) with the results of manual Lachman testing by two orthopedic surgeons. The postsurgical and normal contralateral knees of 51 male and female subjects ages 18 to 49 years (mean, 27.3 ± 7.5 yrs) who had undergone anterior cruciate ligament reconstruction were tested at an average of 47.6 ± 20.7 months postsurgery (range, 24 to 101 months). The instrumented Lachman tests were measured in millimeters of anterior tibial displacement under 90 Newton loads, while the manual Lachman tests were quantified using a subjective point scale. Results of paired *t*-tests revealed significant differences in Lachman test results between the postsurgical and normal knees for both modes of testing ($p < .001$). A Cramer's *V* correlation of $V = .27$ was found between instrumented and manual Lachman test results ($p > 0.05$). The correlational analysis suggests that the "art" of physical examination as practiced by orthopedists and others involves several associated factors, primarily the individual and subjective interpretation of ligament test results, which may make direct comparisons with objective test data quite low.

Objective measurement of knee ligament laxity has only recently become clinically prevalent due to the commercial availability of specific testing devices. Consequently, the history of *in vivo* (in a living organism) instrumented knee ligament examination is rather brief. Early objective testing studies employed complex laboratory devices capable of measuring uniplanar and/or multiplanar laxities, but these devices lacked the portability necessary for clinical use (9,16,18,20,21). More recently, commercial knee arthrometers such as the KT-1000 (MEDmetric Corp., San Diego, CA), the Stryker Knee Laxity Tester (Stryker Corp., Kalamazoo, MI), and the Genucom system (FARO Medical Technologies, Inc., Montreal, Canada), among others, have enabled clinicians to objectively quantify knee ligament laxity (1,3,5,8,10,12,19,23,25).

The standardization of a classification system for ligament laxity by the American Medical Association in 1968 (4), later revised by Hughston and his associates (13,14) greatly improved the clinician's ability to categorize knee laxity/instability with manual ligament stress tests. While the utilization of this system has been extremely successful, manual examination techniques will always lack total objectivity, as the grading of ligament laxity and/or instability can be influenced by the amount of external force applied by the examiner, the

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position and/or angle of the joint when tested, the accuracy of estimation of the displacement, and subjective bias. Instrumented knee ligament laxity testing is designed to control these variables.

The purpose of this study was to compare the experimental results of instrumented Lachman tests for anterior cruciate ligament laxity employing a KT-1000 arthrometer with the results of manual Lachman tests performed by two orthopedic surgeons, on the postsurgical and contralateral normal knees of patients who had previously undergone autogenous anterior cruciate ligament (ACL) reconstruction.

METHODS AND MATERIALS

The postsurgical and normal contralateral knees of 51 male and female subjects ages 19 to 49 years (mean, 27.3 ± 7.5 yrs) who had undergone combined intraarticular and extraarticular autogenous ACL reconstruction at the Orthopedic and Fracture Clinic of Eugene, Oregon were evaluated at an average of 47.6 ± 20.7 months after surgery (range, 24 to 101 months). Prior to participation in the study, each subject signed an informed consent form in accordance with guidelines established by the University's human subjects research committee.

The Lachman test (26) was selected as the evaluative parameter in our study since it can be performed manually as well as with instrumentation. Further, the Lachman test has repeatedly been demonstrated to be the most valid and versatile diagnostic test of the integrity of the anterior cruciate ligament (1,2,3,6,10,11,15,20,21,24).

Instrumented Lachman tests measured the actual millimeters of anterior tibial displacement relative to the femur under 90 N (20 pound) loads applied with the KT-1000 arthrometer. The arthrometer protocol recommended by Daniel et al. (5) was employed, and both the postsurgical and contralateral normal knees of each subject were tested. Each subject was positioned with both knees flexed to 26 ± 3.1 degrees. Three repetitions of the 90 N instrumented Lachman test were performed, first on the normal knee and then on the postsurgical knee. Three-trial average tibial displacement values were subsequently calculated. Instrumented Lachman tests for all subjects were performed by one of us (RAH) to eliminate interrater variability.

The manual Lachman tests were conducted as part of a complete orthopedic physical examination, and the clinical results were scored with a subjective seven-point scale. Two orthopedic surgeons (KMS and SAC) performed the clinical examinations on all 51 subjects. Seven points were awarded for a negative Lachman sign ("normal" laxity), four points awarded for a positive Lachman sign (anterior displacement of the tibia with a firm endpoint), and zero points were awarded to a knee with a positive Lachman sign with a mushy or nonexistent endpoint. To reduce and/or eliminate examiner bias, the physicians did not evaluate their own surgical patients.

The seven-point scale used to quantify the manual Lachman tests was restricted in its range, as only three possible values, 7, 4, or 0, could be awarded. Therefore, in order to correctly determine the magnitude of the relationship be-

tween the manual and instrumented Lachman tests, nonparametric statistical treatment was necessary. The continuous (ordinal) data obtained with the knee arthrometer and manual tests were converted into categorical (nominal) variables with the use of dummy code values. For the results of the manual Lachman tests, a negative Lachman sign was coded "1," a positive Lachman sign with a firm endpoint was coded "2," and a positive Lachman sign with a mushy or nonexistent endpoint was coded "3." In converting the instrumented Lachman tests, arthrometer laxity values were divided into four categories patterned after existing nomenclature for the classification of ligamentous injuries (4,13,14). Specifically, 0 to 4.9 mm of anterior laxity was coded "1" (grade 1+), 5.0 to 9.9 mm of laxity was coded "2" (grade 2+), 10.0 to 14.9 mm of laxity was coded "3" (grade 3+), and greater than 15.0 mm of laxity was coded "4" (grade 4+).

The instrumented and manual Lachman test data were analyzed using paired t-tests to determine the presence of differences in anterior ligament laxity between postsurgical and contralateral normal knees. Following conversion of the continuous variables to categorical, a chi-square test was conducted to determine whether a significant relationship existed between the manual and instrumented Lachman test data. Cramer's V coefficient was then calculated to determine the strength of the relationship between the two methods of evaluation.

RESULTS

Statistically significant differences ($t(50)$, $p < 0.001$) between the postsurgical and contralateral normal knees were present for both the instrumented and manual Lachman tests. Average anterior tibial displacement values under 90 N loads with the KT-1000 were 8.1 ± 3.5 mm for the ACL reconstructed knees, and 6.2 ± 2.1 mm for the contralateral normal knees. The average scores on the seven-point manual Lachman tests were 5.5 ± 1.5 points for the postsurgical knees compared with 7.0 ± 0.0 points for the normal contralateral knees. The range and frequency of postsurgical and contralateral normal anterior knee laxities as measured by the 90 N instrumented Lachman tests are presented in Table 1.

The chi-square test was not statistically significant (Table 2). A Cramer's V correlation coefficient of $V = .27$ was found between the instrumented and manual Lachman test results. [Note: The Cramer's V coefficient is based on chi-square, is always positive in value, and ranges between no association at all ($V = 0$) to perfect association ($V = +1$). Unlike the older contingency coefficient (ϕ), Cramer's V does not depend upon the size of the table, and can represent a perfect correlation (27)].

DISCUSSION

Few *in vivo* normative studies currently exist for instrumented testing of knee anterior cruciate ligamentous laxity (5,12,17,21). Daniel et al. (5) evaluated 338 normal subjects using 89 N instrumented Lachman tests with a KT-1000 arthrometer and found an average of 5.8 ± 1.9 mm anterior laxity in left knees and 5.5 ± 1.8 mm laxity in normal right knees. Our normal knee data using a KT-1000 arthrometer

TABLE 1. Range and frequency of normal and postsurgical knee anterior tibial displacement values for instrumented 90 N Lachman tests as measured with a KT-1000 arthrometer

Anterior tibial displacement (mm)	FREQUENCY	
	Normal knees (N=51)	Postsurgical knees (N=51)
2	4	-
3	2	2
4	3	5
5	8	5
6	7	7
7	13	8
8	10	5
9	1	8
10	1	1
11	2	2
12	-	2
13	-	-
14	-	1
15	-	2
16	-	1
17	-	1
18	-	1

compare favorably (mean, 6.2 ± 2.1 mm) with the normal knee normative data reported by Daniel et al. (5), and provide support for the reliability of the KT-1000 device.

For the Lachman tests and other ligament stress tests, the *relative* difference in laxity between knees is often a more important value than the absolute difference. Daniel et al. (5) reported that 92% of their 338 normal subjects had right-left knee differences of no more than two millimeters. The average relative difference between postsurgical and contralateral normal knees in the present study was less than two

millimeters (mean 1.9 ± 3.4 mm). Fifty-two percent of our subjects had relative differences in anterior laxity of two millimeters or less between their postsurgical and normal contralateral knees. If we apply the norms compiled by Daniel et al. (5), approximately one-half of our subjects possessed "normal" right-left knee differences in anterior laxity following ACL reconstructive surgery on one of their knees.

We expected a greater correlation between the results of the instrumented and manual Lachman tests ($V=.27$). One possible explanation for the low correlation between these two modes of testing may be found in the units of measure employed for each. The instrumented Lachman tests measured millimeters of anterior tibial displacement, while the manual Lachman tests used a subjective rating scale with particular point scores awarded based upon the amount of observed laxity and the integrity of the endpoint.

According to Torg et al.(26), a positive Lachman test is one in which there is a visual and/or proprioceptive anterior translation of the tibia relative to the femur with a characteristic "mushy or soft endpoint," indicative of ACL disruption. It is important to understand that the original evaluative criterion for the manual Lachman test described the quality of the endpoint (either "hard" or "soft/mushy"), rather than the number of millimeters of anterior tibial displacement observed when the instrumented test is performed. Other authors (7,22) have noted the importance of the character or quality of the endpoint resistance in manual tests for knee ligamentous laxity. Marshall and Baugher (22) observed that for any intact ligament, there should be a hard or abrupt stop to any motion when that ligament is stressed. Conversely, if a ligament (or ligament substitute) is not intact, the endpoint of the stress test will be soft or indistinct. It may then be argued that ligament integrity may be correctly assessed through the subjective determination of endpoint quality of manual stress tests.

Our results suggest that the "art" of physical examination as practiced by physicians, athletic trainers, and physical

TABLE 2. Crosstabulation of chi-square analysis of postsurgical knees: 90 N instrumented Lachman tests by manual Lachman tests (a)

KT-1000 Results	Manual Lachman Tests (N and %)			TOTAL (N and %)
	Normal Knee (Negative Lachman)	Positive Lachman test with endpoint	Positive Lachman test without endpoint	
0 to 4.9 mm anterior laxity	5 (9.8%)	2 (3.9%)	0 (0%)	7 (13.7%)
5.0 to 9.9 mm anterior laxity	18 (35.3%)	15 (29.4%)	0 (0%)	33 (64.7%)
10.0 to 14.9 mm anterior laxity	2 (3.9%)	5 (9.8%)	0 (0%)	7 (13.7%)
≥ 15.0 mm anterior laxity	1 (2.0%)	3 (5.9%)	0 (0%)	4 (7.9%)
TOTAL	26 (51%)	25 (49%)	0 (0%)	51 (100%)

(a) Chi-square analysis was not statistically significant ($p=.28$).

therapists, among others, involves several associated factors. Specifically, the individual and subjective interpretation of the manual ligament test results may make direct correlation with objective test data quite low. It is possible that a higher correlation may have been present between the two tests had the orthopedists performing the tests been asked to quantify the number of millimeters of anterior tibial displacement they perceived rather than categorically classifying the knee laxity and awarding point values.

For the clinician, a practical question remains to be answered: Is the investment required to purchase an instrumented ligament testing device warranted given the diagnostic accuracy of such a device, or do manual examination methods provide equally accurate, reliable, and valid data? In our study, the results of both methods of evaluation revealed significant differences in anterior ligamentous laxity between postsurgical and contralateral normal knees. However, in a recent study comparing manual testing with the KT-1000, Stryker, and Genucom instrumented testing devices, Anderson and Lipscomb (1) concluded that the clinical examination by an experienced examiner was the most accurate means of determining ACL integrity.

While we would intuitively conclude that objective, instrumented measurement of knee laxities is superior to manual methods for the reasons previously stated in this paper, the results of our study and those of Anderson and Lipscomb (1) suggest that further investigation is required to definitively evaluate the diagnostic accuracy of the instrumented and manual methods of assessing anterior tibial displacement with the Lachman test.

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Non-medical Substance Use Among Athletes at a Small Liberal Arts College

Kenneth J. Blood, MS, ATC

ABSTRACT: Two hundred forty-four students at an NCAA Division III school were asked during the fall of 1987 to complete a questionnaire indicating recent and lifetime use of eleven substances. Responses (n=238) were used to compare the prevalences of substance use in athletes to that of non-athletes. Chi-square analysis revealed that athletes had a greater lifetime experience with alcohol. Athletes had a greater recent and lifetime experience with smokeless tobacco. Non-athletes had a greater lifetime experience with smoking tobacco. Additionally, males had a higher recent and lifetime experience with smokeless tobacco than females. Males also had a greater lifetime experience with both cocaine, hashish, and LSD. An Analysis of Variance (ANOVA) revealed that males were more likely to have tried a licit and an illicit drug than females. Although this research supports previously published data on athlete versus non-athlete drug use, it does not assure that university focused studies mimic small college results. More research is needed to examine the substance use patterns of students at small colleges, and to determine if any relationship may exist between said use and athletic participation.

Substance use and abuse is a problem which occurs in all aspects of society. Numerous papers have documented the use of substances among the general population, and specifically among athletes (4, 5). Some research has compared substance use between athletes and non-athletes (2,3,7,8). Very little data is available on the substance-use practices of athletes in a small college setting.

METHODOLOGY

Students from an NCAA Division III college (1046 full-time enrollment) were surveyed during a seven day period in November 1987. I entered eighteen randomly selected classes and surveyed each student attending class on that day, using a questionnaire. Confidentiality and anonymity were guaranteed.

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Students were asked to identify their class rank, sex, and full-time versus part-time status, and to identify themselves with one of three populations: varsity athlete, recreational athlete, or non-athlete. For the purpose of this study, "varsity athlete" was limited to those students who had or would participate on a varsity sports team during the 1987-88 school year. "Recreational athlete" and "non-athlete" were combined to include all respondents who were not varsity athletes.

Students then answered questions concerning their recent use of eleven substances: alcohol, amphetamines, barbiturates, cocaine, hashish, heroin, LSD, marijuana, steroids, smokeless tobacco, and smoking tobacco. Recent use was confined to a student having used a substance since the beginning of the school semester (70 days).

Data was compiled and analyzed using inferential statistics with the assistance of SAS for Personal Computers.

There was no effort made to identify what sport each athlete participated in. I felt this might cause the respondents to think that it was possible to be identified with the questionnaire. No effort was made to identify levels of use, methods of use, causes of use, or sources of any substance in question. The questionnaire was kept brief intentionally so that I could gain access to classrooms to do the survey. This enabled me to achieve a virtual 100% return rate.

RESULTS

The number of students sampled totalled 244. Six questionnaires were not used in the analysis; two of the six were turned in blank; one student indicated being a part-time student (therefore ineligible for varsity athletics). Three forms were improperly completed.

The number of samples used in analysis represents 22.8% of the college student population during the fall of 1987. Males accounted for 52.9% of those sampled. This compares with an actual male percentage of 54.7% on campus.

Athlete Versus Non-Athlete

Lifetime and semester experience for athletes and non-athletes of the eleven substances in this study are listed in Table 1. More athletes had used alcohol at some time in their lives than non-athletes. Athletes also had a greater lifetime and recent experience with smokeless tobacco than non-athletes did. Non-athletes had a greater lifetime experience with smoking tobacco.

TABLE 1. Substance use comparing athletes to non-athletes

Substance	Frequency	Athletes 85 (36%)	Non-Athletes 154 (64%)	χ^2	p
Alcohol	ever	82 (96.4)	138 (89.6)	3.52	.06
	semester	69 (81.1)	125 (81.1)	.00	.99
Amphetamines	ever	7 (8.2)	13 (8.4)	.003	.96
	semester	1 (1.1)	4 (2.6)	.54	.46
Barbiturates	ever	1 (1.1)	4 (2.6)	.54	.46
	semester	0	0		
Cocaine	ever	7 (8.2)	12 (7.7)	.02	.90
	semester	0	2 (1.3)	1.11	.29
Hashish	ever	4 (4.7)	11 (7.1)	.55	.46
	semester	1 (1.1)	0	1.82	.18
Heroin	ever	0	2 (1.3)	1.11	.29
	semester	0	1 (0.6)	.55	.46
LSD	ever	1 (1.1)	4 (2.6)	.54	.46
	semester	0	1 (0.6)	.55	.46
Marijuana	ever	39 (45.8)	58 (37.6)	1.54	.21
	semester	10 (11.7)	19 (12.3)	.02	.89
Smokeless Tobacco	ever	37 (43.5)	40 (25.9)	7.73	.005
	semester	25 (29.4)	18 (11.6)	11.66	.001
Smoking Tobacco	ever	32 (37.6)	80 (51.9)	4.49	.03
	semester	17 (20.0)	43 (27.9)	1.83	.18
Steroids	ever	1 (1.1)	1 (0.6)	.18	.67
	semester	0	1 (0.6)	.55	.46
No Use	ever	3 (3.5)	13 (8.4)	2.12	.15
	semester	11 (12.9)	23 (14.9)	.18	.67

Male Versus Female

Lifetime experience and semester experience of the same eleven substances were compared with chi-square analysis by gender, and are listed in Table 2. As was expected, males had both a higher lifetime and recent experience with smokeless tobacco than did females. Males were also more likely to have ever tried hashish. No females had used LSD, while males were significantly more likely to have used it.

Licit Versus Illicit

Recent and lifetime use of the substances studied were combined to form licit and illicit drug categories [licit: (n=3) alcohol, smoking tobacco, and smokeless tobacco; illicit: (n=8) amphetamines, barbiturates, cocaine, hashish, heroin, LSD, marijuana, and steroids]. An Analysis of Variance (ANOVA) was computed on the total number of licit drugs using sex and athletic participation (athlete versus non-athlete) as factors. The results showed that males (m=1.90) were more likely to have ever used a licit drug [f(1,233)=8.22, p=.004] than females (m=1.50) There was no significant interaction.

An ANOVA was computed on the total of illicit drugs using the same factors. Males (m=0.82) were more likely to have ever tried an illicit drug [f(1,233)=3.26, p=.07] than females (m=0.55). There was no significant main effect of athletic participation, and no significant interaction. Thus, athletes and non-athletes did not differ in their use of licit or illicit substances.

DISCUSSION

Several other studies provide support for the theory that athletes do not use substances at a different rate than non-athletes (2,7,8). Illicit substance abuse trends among college athletes have somewhat paralleled the trends among the general population of the same age (5). College athletes, in general, use drugs at about the same rate as their non-athlete classmates. A study among Big Ten schools revealed no difference in the incidence of use between populations for the drugs that were studied (3).

Toohey and Corder (8) compared substance use (amphetamines, alcohol, cannabis, cocaine, and LSD) between

TABLE 2. Substance use comparing males and females

Substance	Frequency	Males 126 (53%)	Females 112 (47%)	χ^2	p
Alcohol	ever	116 (92.0)	103 (91.9)	.001	.98
	semester	99 (78.5)	94 (83.9)	1.11	.29
Amphetamines	ever	11 (8.7)	9 (8.0)	.04	.85
	semester	2 (1.5)	3 (2.6)	.34	.56
Barbiturates	ever	4 (3.1)	1 (0.8)	1.50	.22
	semester	0	0	0	
Cocaine	ever	14 (11.1)	5 (4.4)	3.56	.06
	semester	2 (1.5)	0	1.79	.18
Hashish	ever	12 (9.5)	3 (2.6)	4.70	.03
	semester	0	1 (0.8)	1.13	.29
Heroin	ever	1 (0.7)	1 (0.8)	.007	.93
	semester	1 (0.7)	0	.89	.34
LSD	ever	5 (3.9)	0	4.54	.03
	semester	1 (0.7)	0	.89	.34
Marijuana	ever	54 (42.8)	43 (38.3)	.49	.48
	semester	15 (11.9)	14 (12.5)	.02	.89
Smokeless Tobacco	ever	68 (53.9)	9 (8.0)	57.16	.00
	semester	40 (31.7)	3 (2.6)	33.84	.00
Smoking Tobacco	ever	55 (43.6)	56 (50.0)	.96	.33
	semester	25 (19.8)	34 (30.3)	3.51	.06
Steroids	ever	2 (1.5)	0	1.79	.18
	semester	1 (0.7)	0	0.89	.34
No Use	ever	9 (7.1)	7 (6.2)	.08	.78
	semester	19 (15.0)	15 (13.3)	.14	.71

67 university level intercollegiate swimmers and 678 non-athletes. There was no difference in use between the two populations. Steroid use was higher among male athletes than female athletes. In my study, the lack of statistical difference in steroid use by gender may have been due to the reported low level of steroid use by the small college athlete (1,2). These results also did not support Toohey and Corder's results with respect to alcohol use by athletes being higher than use by non-athletes, and to cannabis, cocaine, and LSD use being greater for males than females.

Toohey (7) studied substance use among athletes and non-athletes at the university level. The study included a broader sample of athletes from a variety of sports. Substances tested included marijuana, alcohol, barbiturates, LSD, cocaine, and amphetamines. Amphetamine use was significantly higher among the athlete population at one university than at the others. The other four universities' samples showed a higher incidence of barbiturate use among non-athletes. He reported that the higher use of amphetamines was probably due to the ergogenic use of the drug by athletes. In his concluding remarks about the six-year study, Toohey

stated that athletes do not represent any special population, but instead are very similar to the culture as a whole. Where differences were noted between populations, he felt that they were due to ergogenic goals for use. In my study, statistical differences between athletes and non-athletes were found for substances that are not typically used to enhance performance.

Dezelsky, et al. (2) found no difference between the athletic and non-athletic populations with regard to the use of heroin, LSD, sedatives, cocaine, amphetamines, cannabis, or alcohol. Athletes were significantly more likely to have used anabolic steroids. No other differences were found.

Seventy-five to 80% of young adults are reported to have tried an illicit substance (6). This is almost twice as many individuals as the 42.8% lifetime experience noted with an illicit drug among my small college population.

An NCAA contracted survey carried out by Michigan State physicians Anderson and McKeag in 1985 (1) and 1989 (2) measured licit and illicit substance use at eleven NCAA institutions. Both studies included Division III institutions.

The survey assessed prevalence of use among athletes at

each school, making no attempt toward an athlete to non-athlete comparison. The two surveys include data for two years before and after the dates of my sampling. The NCAA study used a twelve-month prevalence for all of the following statistics. Comparing their 1989 results with the results of my sampling reveals a higher percentage of athletes using smokeless tobacco (29% vs. 27%), and a smaller incidence in the use of amphetamines (1% vs. 4%), steroids (0 vs. 4%), barbiturates (0 vs. 1%), marijuana (11% vs. 32%), LSD (0 vs. 6%), alcohol (81% vs. 92%), and cocaine (0 vs. 5%). When broken down into geographical regions, the NCAA midwest schools have a higher percentage of smokeless tobacco users (33%) compared to the other three regions. Although there is no way to determine the number of Division III schools in that region, this may explain the disparity between Division III smokeless tobacco use and the estimates of use in my results (from a Division III/Midwest Region school).

The Anderson and McKeag study also supported the disparity in use of substances between NCAA divisions. Steroid, cocaine, and smokeless tobacco use was similar when comparing Division I athletes to those in Division III. Amphetamine, alcohol, and marijuana use are reported as being higher, and barbiturate use as lower, in Division III.

Even though I guaranteed confidentiality to my respondents, there is a possibility that some did not use complete honesty when reporting their history of substance use. However, respondents seemed to be somewhat uninhibited by the sampling process. It can be argued that no one population is more likely to give false information than another. Therefore comparisons between populations are probably not biased.

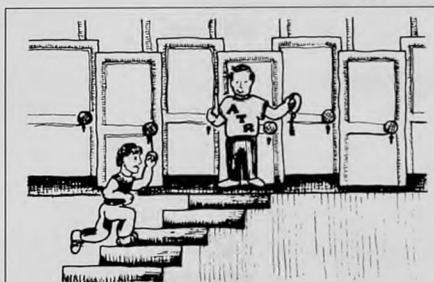
Further research is needed to draw conclusions as to whether there is a relationship between athletic participation and substance use. Results from studies focusing on large universities cannot be assumed to be the same as results for small colleges. There is a definite need for further published research on the level of substance use among the small college athlete and non-athlete populations.

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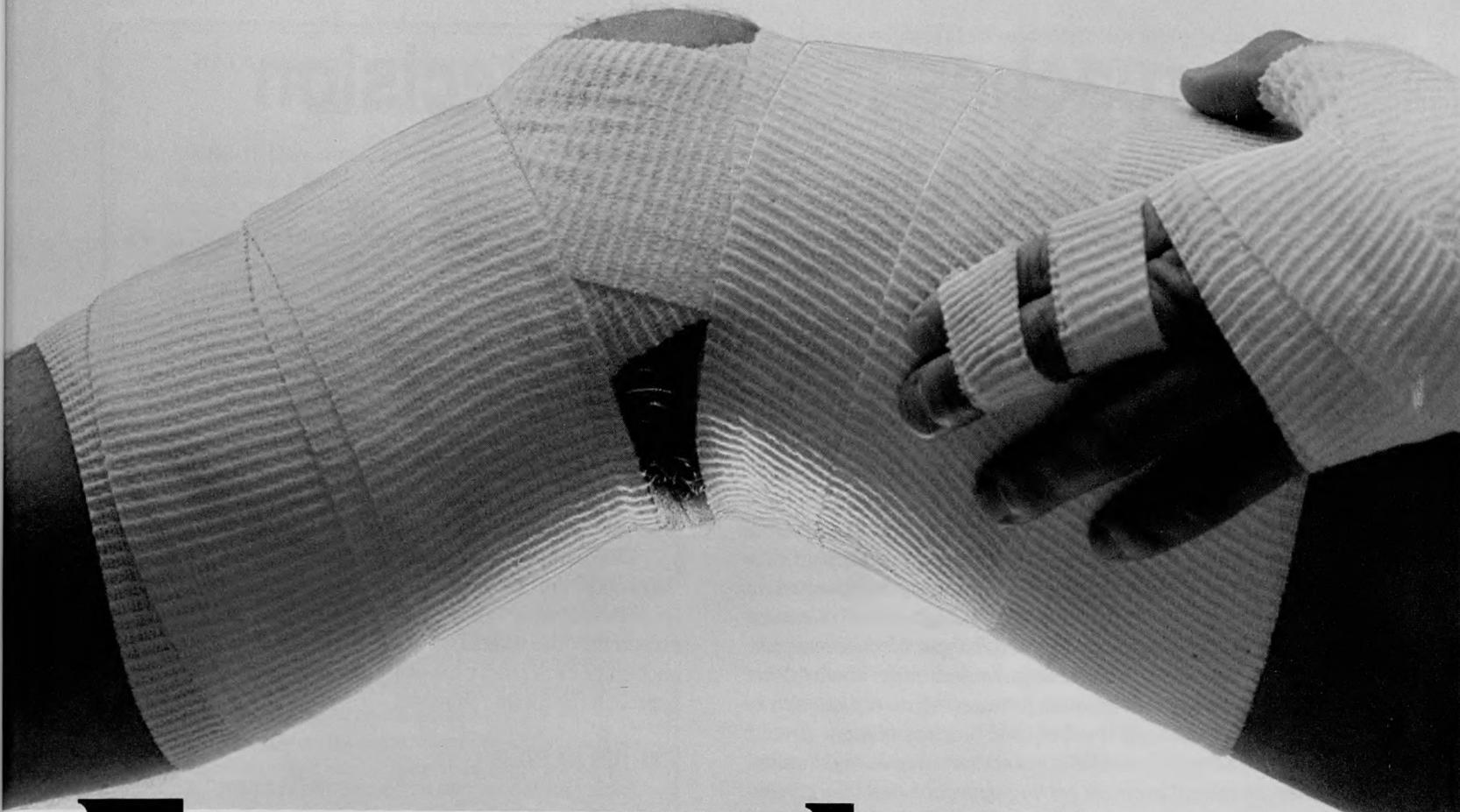
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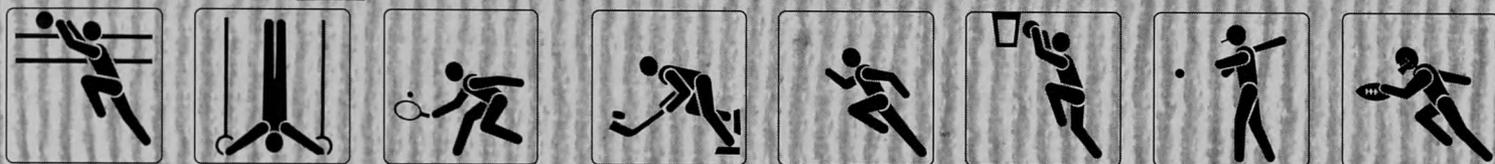
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Approaches to Ethical Decision Making in Athletic Training

Brent C. Mangus, EdD, ATC

Christopher D. Ingersoll, PhD, ATC

ABSTRACT: Athletic trainers may be involved in ethical dilemmas that they have not been formally trained to deal with. As sports and athletics involve more participants, and as athletic trainers work in varying settings, ethical dilemmas arise. In this paper, different ethical problem solving approaches are outlined. A hypothetical case involving an ethical question is presented, followed by an explanation of problem solving approaches and an examination of each possible decision. Athletic trainers are encouraged to develop an ethical problem solving approach that they can implement to evaluate an ethical dilemma if or when one arises.

Ethics has become a major topic of concern in medical and health related fields (1,2). Even student athletic trainers are talking about professional standards and qualities of athletic trainers (3). The NATA has developed a Code of Professional Practice (see Figure 1) which outlines seven basic principles for athletic trainers (4). We believe that athletic trainers, in general, provide the best possible care in an ethically appropriate manner to the athletes they work with; however, some may be crossing ethical boundaries without knowing it.

Athletic training curricula need to include some training in ethical decision making. Most colleges and universities are now offering courses in ethics. These courses might be offered by the philosophy department, the health science department, or elsewhere on campus. At the University of Nevada, Las Vegas, we have incorporated our ethics discussions directly into the coursework in the athletic training curriculum. We recommend this article to those athletic trainers

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who have not been formally instructed in ethics.

The purpose of this paper is to acquaint the athletic trainer with the basic concepts of ethical decision making, and to point out how easily athletic trainers can inadvertently breach the code of ethics. A further intent of this paper is to encourage each reader to develop an ethical problem solving approach for future reference.

ETHICS DEFINED

Ethics is also known as "moral philosophy." Garrett et al. (2) define ethics as a "branch of philosophy that seeks to determine just how human actions may be judged right or wrong."

If we then apply the ideas of "actions" and "judgements" to a profession, we create a model which implies that within our profession we will determine the rules and standards governing ourselves. Furthermore, as humans, we can reason and understand that rules and standards govern our profession and that each person in the group follows the principles as accepted by the group. Additionally, we must judge what behavior or actions are considered right or wrong as part of the professional behavior.

Ethics is not religion or theology; however, many individuals extrapolate their ethical standards from their religious indoctrination, which may be the highest order of validity for these standards. Ethics is not law. Law is important to many as a means by which an act or behavior is judged right or wrong. Ethics goes beyond law and each person's rights. Ethics deals with the responsibility of individuals to themselves and to society (5).

Fundamentally, the individual should believe in the rules and standards of the profession and should make decisions that are beneficial for most of the people within the profession or group. Unfortunately, this is not always possible when individuals and society are in conflict. The individual making the decision will determine who benefits as a result of the action.

ETHICAL PROBLEM SOLVING APPROACHES

We will discuss three basic approaches to ethical problem solving. They include ethical egoism, utilitarianism, and

NATA CODE OF PROFESSIONAL PRACTICE

Ethical Principles

1. Athletic trainers should neither practice nor condone discrimination on the basis of race, color, sex, age, religion, or national origin.
2. Athletic trainers should not condone, engage in, or defend unsportsman-like conduct or practices.
3. Athletic trainers should provide care on the basis of the needs of the individual athlete. They should not discriminate on the basis of athletic ability.
4. Athletic trainers should strive to achieve the highest level of competence. They should use only those techniques and preparations which they are qualified and authorized to administer.
5. Athletic trainers should recognize the need for continuing education to remain proficient in their practice. They should be willing to consider new procedures within guidelines that assure safety.
6. Athletic trainers should recognize that personal problems and conflicts may occur which may interfere with professional effectiveness. Accordingly, they should refrain from undertaking any activity in which their personal problems are likely to lead to inadequate performance or harm to an athlete or colleague.
7. Athletic trainers should use care to be truthful and not misleading when stating their education, training, and experience.

Figure 1. NATA Code of Professional Practice

formalism. The ethical egoism approach resolves the problem by utilizing the solution that results in the greatest benefit to oneself (5). Utilitarians choose a course of action that benefits the greatest number of people (5). Formalists choose a course of action that they would like to see universally employed, i.e., they view their action as doing one's "duty" (1).

As you read the following problem solving approaches, analyze your attitudes and feelings about each solution. Your response will give you a greater insight into how you might approach a decision, and will give you an idea of where your philosophies lie.

HYPOTHETICAL CASE

You have just accepted an athletic training position which enables you to work alongside one of the profession's senior members. You have been well trained and accept the idea that treatment to all athletes should be administered on a fair and equal basis. Jack, the head athletic trainer at this institution, was around long before Title IX. When you accept this job, the coaches and athletes are not happy with the treatment female athletes are receiving. They are treated as though their sports were secondary to any of the men's sports. In fact, there is no athletic trainer assigned directly to women's sports. Jack openly says that women are a nuisance, don't belong in athletics, and should not be taking up time and space in the training room.

Jack has worked at this university for many years and has his own standards set for the care of athletes. Coaches have decided that fighting him does not work.

After you have been working in the training room for one month, the following situation occurs:

A female athlete is brought to the athletic training room with a quadriceps contusion. You, as the assistant athletic trainer, make the immediate evaluation and decide on a treatment which requires the athlete to remain in the facility. Later, when Jack arrives, you are questioned as to her presence. After a short explanation, you are told to get her out before the guys start coming in from practice. Moving her is not of great consequence, but Jack's attitude in the situation concerns you.

Initially, you consider two things: First, his treating females in a "second class" manner is disturbing you and is unethical according to the NATA. Second, Jack has been around for so long that no matter what you say, he is not going to change. If you question his actions, your job security will be jeopardized because of insubordination. Other factors must also be considered. If a dual standard for treatment of athletes exists for any reason, it is unethical according to the NATA Code of Professional Practice. As the junior member of this athletic training team, you must be careful to treat all athletes equally and still remain loyal to your head athletic trainer. It is evident that this is a fine line to walk.

DISCUSSION

A breach of ethical behavior may not always be as evident as in the hypothetical case presented; however, the athletic trainer must keep in mind that a variety of considerations relate to ethical concerns.

First, you must deal with the athletes and their needs. Should you decide to deal with the athlete, you are making an ethical decision. This is true because you have decided to choose from a set of alternatives and now you are dealing with the ethics of this situation. You may have to explain the difficulties you are having with Jack and hope that the athlete will understand.

Dealing With an Ethical Dilemma

You could take one of four basic courses of action in dealing with the scenario above: a) You could report Jack's unethical behavior and try to retain your position as assistant athletic trainer at that institution; b) You could not report the unethical behavior and simply retain your job; c) You could report the unethical behavior and quit your job at that institution; or d) You could not report the unethical behavior and quit your job. Each of these actions will have different short- and long-term results. Not only will your decision affect you, but your choices will also affect others.

Reporting Jack's unethical behavior, either to the NATA Board of Ethics or to authorities at the institution, and choosing to remain on staff, will certainly result in interpersonal conflict. It is likely that Jack will resent your actions, and he may make your work environment unbearable. Additionally, he may attempt to have you terminated for insubordination.

Should you decide not to report Jack's behavior and attempt to maintain your employment at the institution, you will have a number of options. First, you may decide to avoid controversy and tolerate the unequal treatment of athletes. You may decide it is easier to wait until Jack retires before you attempt to make changes in the training room policy toward female athletes. By tolerating this practice, you may be viewed as condoning the prejudicial treatment of women.

You may try to provide "secret" care for female athletes, but it would only be a matter of time before you were caught and questioned by Jack. By subverting his directives, you are essentially involved in an unethical practice.

Choosing to report Jack for his unethical behavior and quitting your job at the institution may have several repercussions. A guilty verdict for unethical behavior does not insure that disciplinary action will be taken against Jack. Loss or suspension of certification, or any of the rights associated with certification, are not guaranteed when an individual is found guilty of unethical behavior. Jack might receive merely a "slap on the wrist" for his behavior. This would not necessarily eliminate discrimination toward female athletes, particularly if you are no longer there to fight for their rights.

There would be no short-term change in the treatment of female athletes. Any long-term change would depend upon Jack's response to charges of unethical behavior. If the Ethics Board reprimands him for his behavior, he may reconsider his position on the treatment of women, and attempt to remedy the situation. On the other hand, he may choose to ignore the recommendations of the Ethics Board and continue to practice discrimination toward female athletes. It is impossible to predict which route Jack will take in this situation.

Failing to report Jack's unethical behavior and choosing to quit your position at the institution will most likely have no effect on the discriminatory behavior practiced by Jack. Although you will no longer be involved with the training room policies at the institution, can you say that you acted in the best interest of the athletes? In the short-term, you have divorced yourself from the problem. In the long-term, however, your actions may have negative consequences. You may be accused of running away from your problems. When you accepted a position at that institution, you agreed to fulfill the responsibilities of a certified athletic trainer. One of these responsibilities is to follow the Ethical Principles (see Figure 1) described in the NATA Code of Professional Practice (4). Direct involvement in discrimination does not necessarily have to occur to be a breach of ethics. Choosing to ignore the problem and avoiding it may also be considered unethical behavior.

The decision you make may depend upon the support you receive from your superiors. If the athletic director (AD) supports you in your decision to report the unethical behavior, the chances of retaliation from the head athletic trainer are reduced. If the athletic director views your choice as going outside the establishment, then it is likely that you will not receive much support for your decision. The AD may prefer that you attempt to go through institutional channels first.

You also may attempt to resolve your differences of opinion with Jack in private discussions. Although Jack may

not change his way of thinking, he may consent to allow you to practice athletic training as you deem appropriate. This represents an improvement in the ethical policies of the athletic training staff toward female athletes, but a breach of ethics will still be present on Jack's part.

There are obviously advantages and disadvantages to each of the actions described above. How you will resolve this ethical question should be based on your ethical decision making process.

The Ethical Egoism Approach

It may be that you will gain professional prestige by retaining your position at the institution. On the other hand, if you feel that a conflict is certain to erupt between you and Jack, and that it will create unbearable working conditions, you may wish to quit your job. In making your decision, the athletes are not a factor in considering the problem and the possible solutions. In either case, it is unlikely that you would report Jack's behavior.

It is possible for two people to choose different courses of action using the ethical egoism approach. The choice is dependent upon your perception of what is best for you. Utilizing the ethical egoism approach does not necessarily ensure that the "right" approach has been chosen.

The Utilitarianism Approach

A utilitarianist would choose to report Jack in an attempt to eliminate his prejudicial behavior and to remain at the institution to ensure that fair treatment is administered. Choosing this route would benefit all of the female athletes at the institution, while creating numerous problems for you and Jack. Again, choosing the utilitarianism approach does not ensure that the correct decision has been made.

The Formalism Approach

In this case, your decision would include consideration of both the fair treatment of the female athletes and the professional integrity of your colleague, Jack. The formalist would most likely try to resolve the unfair treatment of the female athletes during private meetings with Jack. Privately, you would point out your concern for the apparent breach of ethics and attempt to formulate a plan to resolve the problem.

If the problem cannot be resolved in this manner, you would probably feel it necessary to report Jack's behavior. As with the utilitarianism approach, you would most likely attempt to stay at the institution to insure that female athletes received fair treatment. As with the other two, this approach cannot necessarily be considered the "correct" approach.

SUMMARY

This article was intended as an impetus to start you thinking about the ethical dilemmas present in our profession. We have provided a sample of approaches that can be used in the problem solving process. It may seem confusing to say that these approaches are not necessarily "right." However, each solution **may** be correct for you.

It is important to employ a problem solving method to arrive at your solution. Whatever you choose to do, you have

made a choice and you must do everything in your power to complete the process in solving this dilemma.

The NATA has developed a list of seven ethical principles which should be reviewed periodically by each professional in our organization. Additionally, athletic trainers should develop a basic understanding of the principles that constitute ethical behavior.

The hypothetical case demonstrates but one of many situations that involve ethics. Athletic trainers now face drug use by athletes, illegal practices by coaches and athletes, and other unethical conflicts. Professionals need to be prepared with a plan to address these problems.

We should all look for ways to improve our techniques and knowledge in this field. In our quest for improvement, we should look for articles and workshops, take classes, and talk with other athletic trainers to clarify and elicit new ideas about ethics.

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Incidence and Severity of High School Athletic Injuries

Terry J. Whieldon, MS, ATC, PT
Frank J. Cerny, PhD

ABSTRACT: A descriptive, prospective epidemiological study was undertaken at four high schools to determine the incidence and severity of injuries occurring during boys' and girls' interscholastic athletics. Graduate students served as head athletic trainers for each high school and collected data on the incidence and severity of injuries. Severity was categorized according to days of participation lost per 100 athletes and 1000 exposures. Collision sports such as football and wrestling generated the highest injury rates, followed by contact sports such as baseball and basketball, then non-contact/endurance sports such as swimming and tennis. Varsity collision sports did not have higher injury rates than junior varsity collision sports. Boys had higher injury rates than girls in contact sports, but not in non-contact/endurance sports. When high school athletes had easy access to athletic trainers and athletic training facilities, recovery was frequently swift and uneventful. In most cases, injured athletes returned to competition in less than 21 days. The injury rates reported in this study indicate the need for accessible medical attention for high school athletes. Since in most high school settings constant physician coverage is not possible, certified athletic trainers must be available to tend to injured athletes.

More than 1.85 million girls and 3.5 million boys will participate in interscholastic athletics during the school year, with the number increasing annually (7,20). With such participation, a significant number of athletic injuries should be expected, but every effort must be made to limit the potential for injury. The reduction of risk of injury requires the efficient and judicious use of medical resources including paramedical and/or medical coverage for specific athletic events. The decision to use these resources should be based upon epidemiological injury data such as incidence rates, severity, and the circumstances of the injury occurrence (11).

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At present, very few useful data are available on the incidence, severity, and predisposing conditions of youth sports injuries. Mueller and Blythe (13) stated, "Epidemiologic research methods have long guided the attack on communicable and other diseases and are an appropriate approach to the study of athletic injuries." Early attempts at examining athletic injuries provided descriptive information regarding types of injuries and frequencies (2,5,11,12,18,19,24,27,30). Despite the large number of sports-injury studies, most have been inconclusive due to inconsistent injury classification, lack of standardized reporting and recording techniques, and the failure to use appropriate statistical techniques to analyze the data (13,14,15,17,25,26).

The National Electronic Injury Surveillance System (NEISS) used teletype terminals in the emergency rooms of hospitals to gather athletic injury data (21). Other studies have used accident report forms from schools (30), two hospital emergency rooms (30), schools' accident insurance companies (30), local physicians (24,30), and parents, coaches, and supervisors of community sports programs (24,27,30) to collect injury data.

The review of existing studies indicates that appropriate high school athletic injury data may be collected by: 1) placing skilled athletic trainers at athletic practice and competition sites, 2) utilizing standardized injury classification and recording techniques, 3) computerizing data collection techniques so that reports can be made at the time of injury, 4) documenting healing and rehabilitation time, and 5) recording injuries at a number of sites (1,3,7). Most studies to date have not met all five criteria.

The purpose of this study was to examine the incidence and severity of boys' and girls' interscholastic athletic injuries.

METHODS

The population observed consisted of high school athletes, 14 to 18 years old, participating in interscholastic sports. The system used to define an athlete, exposure, and injury was adapted from previous studies (3,8,22,29).

An athlete was defined as one who maintains candidacy for competition by subscribing regularly to the rules and regulations governing participation in interscholastic sports

by the specific public school system. An athlete was "participating" if he or she had health supervisory clearance and coach permission to engage in activities generally expected of his or her teammates. The sport was determined by the type of program the athlete was involved in when injured. Varsity athletic teams were most frequently composed of 16 to 18 year olds in the 11th and 12th grades, while junior varsity athletic teams were most frequently composed of 14 to 15 year olds in the 9th and 10th grades.

Data were collected by graduate student athletic trainers enrolled in the NATA-approved Specialization in Athletic Training program at the State University of New York at Buffalo. Since the graduate students specializing in athletic training had completed at least four years of undergraduate academic training and 800 hours of clinical experience, evaluating and documenting athletic injuries was not a new or unusual experience. All graduate student athletic trainers were certified by the NATA, or had completed all requirements for certification and were scheduled for examination.

The high school athletic training rooms were staffed from approximately 2 p.m. to 6 p.m. each day, and before and after any interscholastic contests where a high level of athletic injuries was common. The interscholastic contests were chosen based on pilot studies completed at two high schools. Before games or practices began each day, athletes were required to report any injuries suffered the previous day, if not initially seen by the athletic trainer. This was a policy of each high school athletic department.

Coaches provided information regarding the number of athletes participating and the number of scheduled practices and games so that the number of potential exposures to injury was recorded. Only those coach-directed sessions which included supervised physical activity were recorded as exposures.

Injury Classifications

An injury was classified as a sports injury only if it occurred during a school-sponsored interscholastic athletic activity. Intramural, extramural, club, and physical education activities resulting in injuries were not included in this study.

Two important areas of epidemiological classification were: 1) documentation of the severity of the injury (the relative impact the injury had on the player), and 2) exposure to potential injury (the time engaged in a particular activity) (3,8,9).

Time lost from participation was used to define the severity of injuries. A nonreportable injury involved an injury/illness which did not require an athlete to miss the next practice/participation day. An injury/illness was reportable if it required substantive professional attention before the athlete could return to participation.

A minor injury constituted a reportable injury/illness which kept the athlete from effective participation for less than one week from the day of onset. Injuries permitting the athlete to return to participation within 8 to 21 days were termed moderate. Inability to return to participation within 21 days from the onset of injury indicated a major injury.

A severe injury was defined as a permanently disabling

injury (e.g., quadriplegia, amputation, or brain damage), or one which resulted in death. This study also included injuries which prohibited return to normal sports activity under this category (e.g., unstable anterior cruciate ligament deficient knee). Injuries occurring near the end of an athletic season were followed in order to document time lost until the athlete had returned to participation in another sport or until he or she was judged rehabilitated by the athletic trainer and school physician.

High school athletic activities were divided into three categories: 1) collision, 2) contact, and 3) non-contact/endurance sports. Collision sports included football, ice hockey, wrestling, and lacrosse (26). Contact sports included baseball, basketball, soccer, field hockey, and softball (26). Non-contact/endurance sports included gymnastics, swimming, track and field, cross-country, tennis, and volleyball (26). Non-contact/endurance sport teams in this study did not compete at the junior varsity level.

Data Analysis

The injury data from each high school were organized and tabulated according to injury severity per athletic activity. The data included incidence (injuries per 100 athletes) as well as exposure (injuries per 1000 exposures) for all injury severity classifications.

The National Athletic Injury/Illness Recording System defined an athletic exposure as each opportunity for an athlete to become injured (e.g., 20 athletes at 10 practices equals 200 athlete exposures) (3,8). This method takes into account the number of injuries that occurred in relation to the number of times an injury could have occurred (e.g., 10/1000 exposures). Also, frequency of injury was related to the incidence of injuries experienced per standard population size (e.g., 2/100 athletes) (3,8). This method allows comparison of the relative frequency of injury to other populations.

A chi-square analysis, "Goodness of Fit Test," was used to examine the distribution of frequencies (4). This was accomplished by squaring the observed and theoretical frequencies and dividing the results by the expected number. The sum of the quotients is the chi-square. We expected equal injury frequencies among sport categories.

The smaller the chi-square, the closer the observed frequency is to the expected. The larger the chi-square, the greater the difference between the observed and the expected frequencies, and the lower the probability that the perceived difference is due to chance. A difference between the observed and expected frequencies was considered significant if the chi-square was equal to the 0.05 level of probability.

Statistical comparisons of injury rates in all severity classifications were made between males and females, and in collision and contact sports between varsity and junior varsity participants.

RESULTS

Collision vs. Contact vs. Non-Contact/Endurance Sports

Significantly higher injury rates for non-reportable, minor, moderate, and total injuries per 100 varsity athletes (Table 1) and total injuries per 1000 varsity exposures (Table 2) oc-

Table 1. A comparison of collision, contact, and non-contact/endurance sport injury rates per 100 athletes (Mean +/- SE)

	Collision	Contact	Non-contact/Endurance	Chi-square Value
Varsity				
Non-Reportable	43.7 (7.2)	13.9 (2.6)	6.1 (0.9)	37.09*
Minor	37.3 (7.2)	20.3 (3.4)	9.9 (1.5)	17.00*
Moderate	9.8 (1.9)	2.8 (0.6)	1.8 (0.5)	7.91*
Major	5.0 (1.8)	4.5 (0.7)	1.2 (0.4)	2.39
Severe	0.4 (0.3)	0.0 (0.0)	0.0 (0.0)	0.80
Total	96.2 (12.8)	41.5 (5.4)	19.0 (2.2)	60.35*
Junior Varsity				
Non-Reportable	48.4 (13.6)	9.7 (1.7)		25.78*
Minor	41.5 (9.9)	10.6 (2.3)		18.33*
Moderate	7.2 (1.8)	1.8 (0.5)		3.24
Major	5.9 (2.7)	0.5 (0.3)		4.56*
Severe	0.0 (0.0)	0.0 (0.0)		0.00
Total	103.2 (24.2)	22.6 (2.9)		51.47*

* Significant at the 0.05 level

Table 2. A comparison of collision, contact, and non-contact/endurance sport injury rates per 1000 exposures (Mean +/- SE)

	Collision	Contact	Non-contact/Endurance	Chi-square Value
Varsity				
Non-Reportable	6.5 (1.1)	2.8 (0.5)	1.3 (0.2)	4.05
Minor	5.5 (1.0)	4.1 (0.8)	1.9 (0.3)	1.72
Moderate	1.5 (0.2)	0.5 (0.1)	0.4 (0.1)	0.93
Major	0.9 (0.3)	0.5 (0.1)	0.2 (0.1)	0.46
Severe	0.1 (0.0)	0.0 (0.0)	0.0 (0.0)	0.12
Total	14.5 (1.9)	7.9 (1.1)	3.8 (0.5)	6.67*
Junior Varsity				
Non-Reportable	7.7 (0.7)	1.9 (0.4)		3.50
Minor	6.2 (1.4)	2.1 (0.5)		2.02
Moderate	1.2 (0.3)	0.3 (0.1)		0.54
Major	0.9 (0.4)	0.2 (0.1)		0.45
Severe	0.0 (0.0)	0.0 (0.0)		0.00
Total	16.0 (3.3)	4.5 (0.6)		6.45*

* Significant at the 0.05 level

curred in collision sports compared to contact and non-contact/endurance sports, and in contact sports compared to non-contact/endurance sports.

Junior varsity athletes participating in collision sports had significantly higher injury rates than those in contact sports, measured both in injuries per 100 athletes (Table 1), and in total injuries per 1000 exposures (Table 2).

Varsity vs. Junior Varsity Sports

Varsity boys participating in collision sports did not have significantly higher injury rates than did junior varsity boys participating in collision sports.

Varsity boys and girls participating in contact sports had significantly higher injury rates for total injuries per 100 athletes than junior varsity boys and girls participating in contact sports. This difference was due entirely to a difference in the girls' injury rates (Tables 3,4).

Contact Sports: Boys vs. Girls

Varsity boys participating in contact sports had significantly higher total injuries per 100 athletes than varsity girls participating in contact sports; however, junior varsity boys participating in contact sports did not have significantly higher injury rates than junior varsity girls participating in contact sports (Table 5).

Table 3. A comparison between varsity boys and girls injuries per 100 athletes (Mean +/- SE)

	Boys	Girls	Chi-square Value
Contact Sports			
Non-Reportable	17.9 (5.0)	10.5 (2.2)	1.93
Minor	25.2 (6.5)	16.2 (2.7)	1.96
Moderate	3.2 (1.1)	2.4 (0.8)	0.11
Major	2.3 (1.0)	2.1 (1.0)	0.00
Severe	0.0 (0.0)	0.0 (0.0)	0.00
Total	48.6 (10.9)	31.2 (3.1)	3.79*
Non-contact/Endurance Sports			
Non-Reportable	6.1 (1.1)	6.9 (1.6)	0.05
Minor	11.3 (2.5)	9.1 (1.8)	0.24
Moderate	2.5 (0.9)	1.1 (0.4)	0.54
Major	1.9 (0.7)	0.5 (0.3)	0.82
Severe	0.0 (0.0)	0.0 (0.0)	0.00
Total	21.8 (3.7)	17.6 (2.70)	0.45

* Significant at the 0.05 level

Table 4. A comparison between varsity boys and girls injuries per 1000 exposures (Mean +/- SE)

	Boys	Girls	Chi-square Value
Contact Sports			
Non-Reportable	3.4 (0.9)	2.2 (0.5)	0.26
Minor	5.1 (1.4)	3.2 (0.6)	4.80
Moderate	0.6 (0.2)	1.0 (0.6)	0.10
Major	0.3 (0.2)	0.4 (0.2)	0.01
Severe	0.0 (0.0)	0.0 (0.0)	0.00
Total	9.4 (2.2)	6.8 (0.7)	0.41
Non-contact/Endurance Sports			
Non-Reportable	1.4 (0.3)	1.3 (0.3)	0.00
Minor	2.3 (0.5)	1.8 (0.34)	0.06
Moderate	0.7 (0.3)	0.3 (0.1)	0.16
Major	0.4 (0.2)	0.1 (0.1)	0.18
Severe	0.0 (0.0)	0.0 (0.0)	0.00
Total	4.8 (0.7)	3.5 (0.5)	0.20

Varsity Non-Contact/Endurance Sports: Boys vs. Girls

Boys participating in non-contact/endurance sports did not have significantly higher injury rates than girls participating in non-contact/endurance sports (Tables 3,4).

DISCUSSION

In a study conducted for the National Athletic Trainers' Association (22,23), placement of athletic trainers in high schools assured consistent injury reporting techniques; however, data from the NATA studies are difficult to compare due to the lack of normalizing techniques for athletic injury exposure (injuries per 1000 exposures) which were used previously in the NAIRS (3,8,9) and the present study. Our data for injuries per 100/athletes are consistent with the percent of total injuries reported by the NATA study (22,23) for the collision (22) and contact (23) categories where data are available.

We addressed these epidemiological design problems by using strict definitions regarding athletes, exposures, and injuries. In addition, our data were collected and entered into a computer daily by athletic trainers placed at the high school sites. Lackland et al. (16) and others (10,11) suggested that the presence of an athletic trainer in the interscholastic setting can improve data reporting, injury prevention, and rehabilitation.

Table 5. A comparison between boys and girls in junior varsity contact sports (Mean +/- SE)

	Boys	Girls	Chi-square Value
Injuries per 100 Athletes			
Non-Reportable	12.8 (2.9)	8.0 (2.0)	0.80
Minor	14.0 (4.0)	7.1 (1.9)	2.26
Moderate	2.2 (0.9)	0.7 (0.5)	0.78
Major	0.4 (0.4)	1.5 (0.8)	0.64
Severe	0.0 (0.0)	0.0 (0.0)	0.00
Total	28.6 (4.5)	17.3 (3.7)	2.78
Injuries per 1000 Exposures			
Non-Reportable	2.1 (0.6)	1.7 (0.6)	0.04
Minor	2.8 (0.9)	1.4 (0.4)	0.47
Moderate	0.7 (0.4)	0.1 (0.1)	0.45
Major	0.1 (0.1)	0.2 (0.1)	0.03
Severe	0.0 (0.0)	0.0 (0.0)	0.00
Total	5.7 (1.0)	3.4 (0.7)	0.58

Collision Sports

Chambers (5) stated that the risk of sustaining a football injury was twice as high as that of sustaining a basketball or gymnastics injury. Soccer, baseball, and swimming had an extremely low risk of injury for athletes ages 6 to 17 years (5). The results of the present study reinforce and extend this information; more injuries occur to high school athletes participating in collision sports than to athletes participating in contact or non-contact/endurance sports at both the varsity and junior varsity levels in all injury severity classifications. While differences between varsity and junior varsity collision sport injury rates were not significant, a trend indicated a potential for equal or even higher injury rates in younger players. This should be monitored in future studies. These data contradict previous work by Violette (28) where junior varsity football players had lower injury rates than varsity football players. His use of interviews of injured players (28) may account for the discrepancy.

Our total injury rate of 96.2/100 athletes in collision sports compares well with other studies demonstrating injury rates of 81/100 and 75/100 athletes in football and wrestling respectively (11,23).

Examination of the rate of return to participation is necessary to complete our understanding of the incidence and severity of the injury rate in collision sports. During a varsity and junior varsity collision sport season, 45 to 46% of the

athletes sustaining injuries returned to unlimited athletic competition without any days lost, 84 to 85% returned in seven days or less, and 92 to 94% returned in less than 21 days. Severe injuries involving permanent disability accounted for less than 0.4% of the reported injuries. These rates compare favorably to a study by Garrick and Requa (11), which indicated 63% of injured football players and 56% of injured wrestlers returned to full athletic participation in five days or less.

These results demonstrated again the number of injuries considered "minor" in collision sports. Intervention strategies, such as employing athletic trainers, must be examined systematically. Further research also must investigate alternative interventions such as rule changes and equipment modification, which could reduce major and severe injuries.

Contact and Non-Contact/Endurance Sports

Previous studies comparing injury rates in male and female high school sports (6,10,11,24) indicated that injury rates were similar for male and female athletes when male collision sports were omitted. Generally, females had more knee injuries and more severe ankle injuries (24). Our results showed similar injury rates in male varsity contact sport athletes and female varsity athletes; however, comparisons made per 100 athletes did show that males had a higher number of total injuries. The rates of injury reported by Shively et al. (24) for contact sports were significantly lower than the rates reported by us and others (10,11). Possibly, the telephone interview system used by Shively et al. (24) to collect data did not identify as many injuries as on-site athletic trainers did when reporting injuries daily.

Again, examination of the rate of return to participation is necessary to complete our understanding of the incidence and severity of the injury rate in contact and non-contact/endurance sports. During a varsity and junior varsity contact sport season (male and female), 36 to 43% of the athletes sustaining injuries returned to unlimited athletic competition without any days lost, 89% returned in seven days or less, and 96 to 97% returned in less than 21 days. Previous studies also demonstrated that a majority of injured male and female athletes returned to full athletic competition in less than seven days (10,11). No athlete received severe injuries involving permanent disability in contact and non-contact/endurance sports in the present study.

To prevent injuries in female athletes, some (6,10) have suggested that women athletes need to undergo gradual conditioning programs to develop optimal levels of strength, power, flexibility, and endurance. These authors further suggested that female athletes, in many cases, were not only limited in particular sports experiences, but also limited in athletic experiences in general (6,10), which may lead to higher injury rates in females. While the present data did not show a higher injury rate in females, the attempt to reduce injuries by progressive participation and gradual conditioning seems prudent.

During a varsity non-contact/endurance sport season, 31% of the athletes sustaining injuries returned to unlimited athletic competition without any days lost, 82% returned in

seven days or less, and 92% returned in less than 21 days. Previous work demonstrated that nearly three-fourths of athletes in non-contact/endurance sports missed fewer than five days of practice and competition due to their injuries (10,11). Further research must investigate interventions designed to reduce nonreportable and minor injuries.

Appropriate Utilization of Athletic Trainers

The distribution of injuries in the present study indicates that athletic training coverage is prioritized. In varsity collision sports, having a certified athletic trainer or physician available only on game days is not acceptable. Since other studies indicated a high incidence of injuries during practice in boys' collision and contact sports (10,11), a certified athletic trainer should be available during both practice and games. The similar injury rate in girls' contact sports also indicates the need for appropriate coverage by a certified athletic trainer.

While our data do not directly indicate the need for athletic trainers in non-contact/endurance sports, the incidence of injury suggests a need for a certified athletic trainer on a daily basis to care for less severe injuries in order to prevent these from becoming major injuries. Educating non-contact/endurance sports athletes regarding overuse injuries, warm-up, conditioning, etc., should become a priority for the high school certified athletic trainer.

CONCLUSIONS

This study demonstrated that an extremely high percentage of high school sports injuries are rehabilitated in less than 21 days when an athletic trainer is available. When high school athletes had easy access to athletic trainers and athletic training facilities, recovery rates were swift and uneventful (10,11,16). Comparisons to injury rehabilitation rates at high schools without athletic trainers are impossible. Reliable and valid data are not available due to the numerous data collection problems cited.

The injury rates reported in this study indicate the need for accessible medical attention for high school athletes. Since in most high school settings constant physician coverage is not realistic, certified athletic trainers must be available to care for injured athletes.

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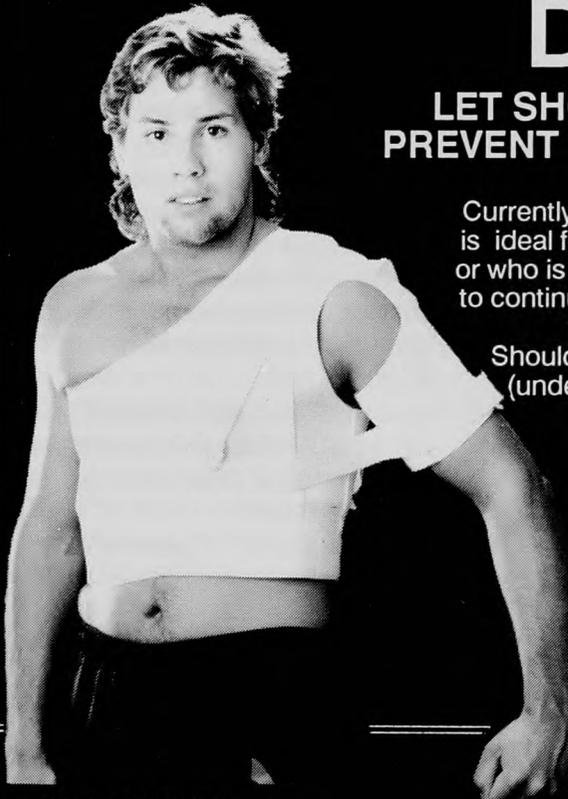
We would like to thank the students who assisted us for their dedication and commitment to improving the health care of high school athletes through athletic injury research.

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Case Study

Sciatic Nerve Entrapment

A Cause of Proximal Posterior Thigh Pain in Athletes

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ABSTRACT: *The following case report describes the history of a seventeen-year-old female athlete who complained of chronic proximal posterior thigh pain following athletic competition. This problem is common among athletes and often distinguished as entrapment of the sciatic nerve by the piriformis and hamstring muscles. Clinical findings presented explain related symptomatology and the pathogenic nature of sciatic nerve entrapment. Pain management included the use of physical therapeutic modalities to assist the athlete in maintaining an appropriate level of comfort and performance. Because of the patho-mechanical involvement of the hamstring muscles in this case, the surgical procedure of choice was correction of the sciatic nerve with neurolysis and hamstring recession. The results were excellent and the athlete returned to physical activity within six weeks following surgery.*

Not all sciatic pain is related to spinal involvement, but may indicate compression of the sciatic nerve within the region of the upper buttock (1,2,6). Sciatic nerve entrapment has been reported as a cause of proximal posterior thigh pain (2,6). Often this particular etiology is related to hyper-

irritability of the piriformis muscle (1) and is commonly diagnosed as *piriformis syndrome*. Puranen and Orava (7) note that hamstring involvement is more common than *piriformis syndrome* and describe *hamstring syndrome* as a new clinical entity.

Additional related pathologies with the similar clinical symptom of proximal posterior thigh pain include ischiogluteal bursitis (8), posterior chronic compartment syndrome (10), and recurrent hamstring strain and tear (3,4,5). In these related cases, pain is both diffuse and local, with or without radicular symptoms. A positive Lasègue's test (9), Pace's sign (6), and Freiberg's sign (2) help in differentiating a diagnosis of sciatic nerve entrapment (7).

This report describes a non-traumatic history involving sciatic nerve entrapment by both the piriformis muscle and the adjacent posterior thigh musculature. It further corroborates past surgical results in the treatment of sciatic nerve entrapment with neurolysis and hamstring recession.

PRESENTATION OF CASE

A seventeen-year-old female athlete participating in high school basketball complained of chronic unilateral pain of the posterior non-dominant left hip in January 1989. At initial presentation, she complained of non-radicular pain in the gluteal and proximal hamstring regions with some point tenderness over the sciatic notch. No previous history of hip or spinal pathology was related by the athlete. Normal muscular symmetry, limb length, and hip and pelvic mechanics were noted. A negative Lasègue's test (9) [Figure 1(A) and (B)], and Freiberg's sign (2) (Figure 2) were recorded. Pain, however, was demonstrated with resistive hamstring flexion at the point of origin. Pain was further elicited in resistive hip abduction with external rotation (Pace's sign) (6) (Figure 3). She complained of pain following athletic participation with tenderness along the proximal posterior/lateral aspect of the thigh. No particular functional limitations were

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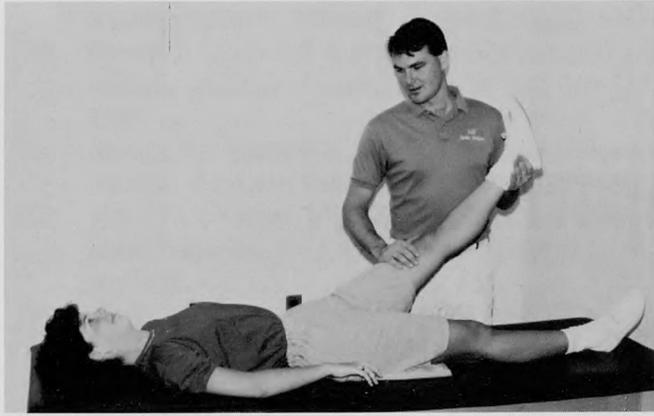


Figure 1A. Lasègue's Sign. The examiner raises the involved leg where radicular symptoms are experienced.

noted prior to physical activity. Concentric isokinetic evaluation (Cybex II Plus Orthopedic Protocol) of the hamstrings (upright position) was unremarkable. Initial clinical signs of muscular herniation and/or tearing, including reduction in hip, knee, and pelvic motion, diffuse swelling, disruption in muscle symmetry, ecchymosis, et cetera, were absent. Neurological examination was normal.

A diagnosis of chronic hamstring strain with piriformis involvement was made. Cryotherapy was prescribed with compression for seventy-two hours following athletic participation. Follow-up therapy and medical re-evaluation continued weekly until March 1989. The athlete remained in competition throughout the winter season, participating with a compressive wrap over the hip and proximal hamstring area. Moderate, chronic pain was recurrent and was clinically managed weekly with alternating cryotherapy and moist heat, non-steroidal anti-inflammatory medication, and ultrasound therapy.

In order to rule out a fracture, a bone scan was performed in February 1989. Results concluded normal bony physiology. Pain and general post participatory discomfort continued into the spring season with no specific relief of symptoms. Magnetic resonance imaging (MRI) was performed in March 1989 to rule out the possibility of soft tissue disorders. Results demonstrated no evidence of joint fluid within either femoral



Figure 2. Freiberg's Sign. The patient lies prone, with the knee flexed, and the examiner inwardly rotates the extended thigh. The test is positive if limited motion is noted indicating spasm of the external rotators of the hip.

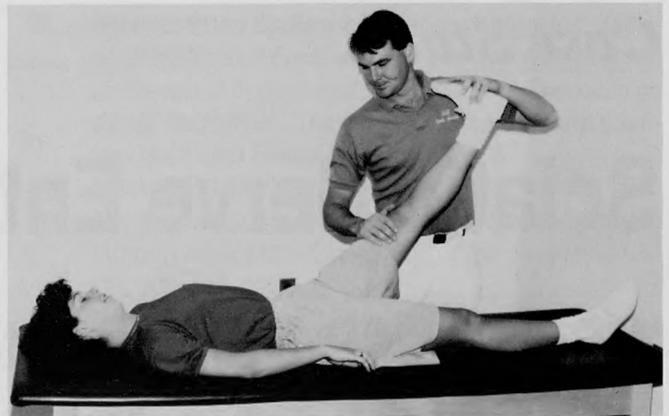


Figure 1B. Lasègue's Sign. The leg is lowered until no pain is felt. The ankle is dorsiflexed; if radicular pain is experienced, the test is positive for sciatic nerve stretch or irritation.

acetabular joint capsule. Additionally, adjacent musculature and subcutaneous fat were considered unremarkable.

The athlete participated in a pre-season conditioning program during the summer months in preparation for the fall field hockey season. The program included progressive resistive exercise training and vigorous static large muscle stretching for total leg conditioning. The athlete returned to competition in September 1989.

Following three weeks of physical activity, an exacerbation of symptoms, identical to those present at the initial January 1989 evaluation, occurred. The athlete was orthopedically re-evaluated, counseled on the pathomechanical nature of her pain, and informed that her pain probably would not diminish without corrective surgery. Surgical neurolysis of the sciatic nerve was subsequently performed in October 1989.

OPERATIVE FINDINGS

Surgery revealed diffuse fascial and fibrous bands running transversely from the origin of the sciatic nerve (Figure 4). In addition, tight gluteal fascia and tendinous origins of the hamstrings produced diffuse sites of localized compression of the sciatic nerve and the posterior cutaneous nerve of the thigh. Dissection of all fascial structures entrapping the



Figure 3. Pace's Sign. The patient is seated on the edge of an examining table. Resistance is applied to abduction/external rotation of the hip. The test is positive if weakness or pain occurs about the area of the sciatic notch.

sciatic and posterior cutaneous nerves was surgically performed from the sciatic notch proximally into the upper portion of the thigh distally.

A recession of the semi-membranosus and biceps femoris tendons was performed and allowed to release approximately one centimeter. This essentially lengthened a portion of the hamstring tendons that crossed the lower portion of the sciatic nerve. The sciatic nerve and posterior cutaneous nerve of the thigh were neurolysed and freed along their entire length. No fascial entrapment over the ischial tuberosity or adjacent musculature was noted.

The athlete tolerated the surgery well and was placed in a compressive bandage about the hip. During the six-week recovery, pain diminished markedly. Following orthopedic evaluation (seventh week post operative), the athlete was permitted to return to competition after functional conditioning and evaluation by the school athletic trainer. Athletic participation has continued from December 1989 to the present without any signs of sciatic nerve entrapment.

DISCUSSION

This case illustrates some clinical difficulties in diagnosing and treating proximal posterior thigh pain. In such cases, the use of a bone scan and MRI to rule out the presence of fracture and/or soft tissue disorders is medically appropriate. Additionally, computed tomography, myelography, and electroneuromyography (ENMG) are used to differentiate sciatic nerve entrapment from other related pathologies which cause proximal posterior thigh pain (3,4,5,7,8,10).

Puranen and Orava (7) presented findings of athletes with related hamstring involvement in a series of fifty-nine patients complaining of pain over the area of the ischial tuber-

osity with radicular symptoms to the back of the thigh. Results indicated complete relief in fifty-two cases undergoing hamstring recession. Equally important, their work demonstrated a higher frequency (three to one) of *hamstring syndrome* than *piriformis syndrome* (7). The explanation for this type of pathogenesis is an overcompensation by the hamstrings in power related activities, vigorous ballistic stretching, or repeated chronic hamstring tearing from the point of origin (3,4,5,7). Likewise, chronic rupture results in tissue scarring and in the formation of densely thick fascial bands over the sciatic nerve and posterior cutaneous nerve of the thigh (3,4,5,7). No definitive research, however, substantiates these hypotheses.

This report supports earlier research pertaining to hamstring involvement in sciatic nerve entrapment. The distinguishing characteristics of this case include the non-radicular aspect of the posterior thigh pain, the negative Lasègue's test and Freiberg's sign, the involvement of the piriformis and hamstring muscles with both the sciatic and posterior cutaneous nerve of the thigh, and the chronic post-participatory pain. Such symptoms assist in differential diagnosis of sciatic nerve entrapment. Also, in cases with similar pathologies, surgery is often indicated to free any peripheral nerve compression site(s). Further, this report encourages the use of physical therapeutic modalities in the management of sciatic nerve entrapment. Finally, the authors conclude that surgical correction of sciatic nerve entrapment, with neurolysis of the sciatic nerve and posterior cutaneous nerve of the thigh, and with hamstring recession, is safe, relatively simple, and produces good results with a return to athletic competition.

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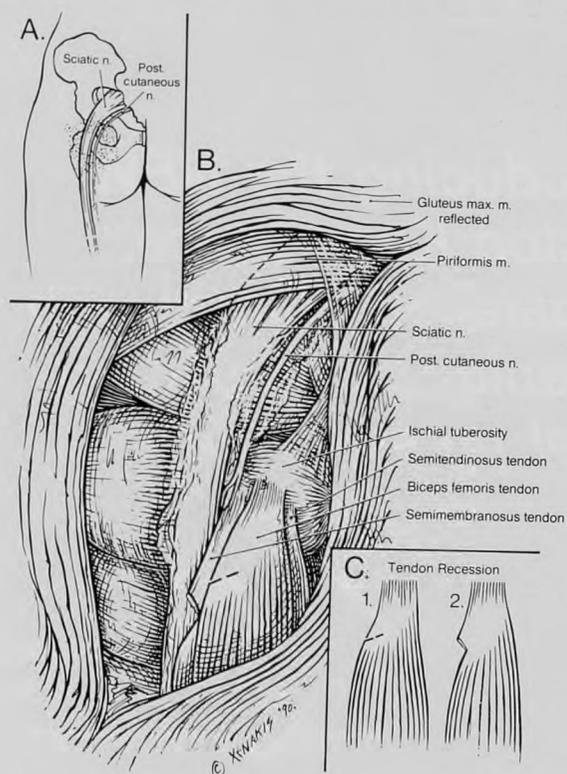


Figure 4. A) Nerve compression sites, B) deep gluteal anatomy, C) tendon recession of biceps femoris and semi-membranosus.

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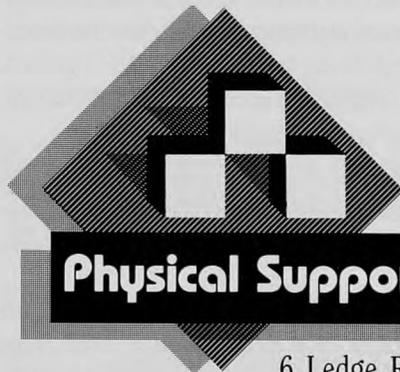
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Iliotibial Band Friction Syndrome

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ABSTRACT: Iliotibial Band Friction Syndrome (ITBFS) is an overuse injury commonly found in runners, cyclists, and weight lifters. A thorough understanding of the anatomy involved is essential in order to rule out other knee pathologies. When performing a systematic evaluation, the examiner should obtain a complete history, inspect for structural abnormalities, palpate the structures about the knee, and perform various strength and special tests to arrive at an accurate assessment. Once an assessment is made, the patient should be informed of the importance of time in dealing with this injury in order to avoid recurrence. The injury should be treated conservatively initially. This involves the systematic progression of rest, stretching, modality use, medication, possible steroid injections, strengthening, and gradual return to activity. If conservative measures are unsuccessful, then surgery may be necessary.

The Iliotibial Band Friction Syndrome is an overuse injury in which friction of the iliotibial band over the lateral femoral epicondyle causes an inflammatory response and results in pain. A review of the literature indicates that the signs and symptoms are classic and uniform throughout affected patients. The ITBFS was first described sufficiently by Renne (18) in 1975 when year-round training was becoming a common practice for most sports, with a subsequent rash of overuse injuries. Since that time, many other articles have been published (2,3,6,10,14,15,16,17,18,20). The etiology and treatment protocols are well documented, but the litera-

ture fails to address the need to avoid confusing this injury with other unrelated knee pathologies. Also absent from the literature is the need for athletic trainers and athletes to realize the importance of patience and time for healing when treating this injury. The primary points of this article are to illustrate a systematic method of evaluation of ITBFS, based on regional anatomy, in order to arrive at an accurate assessment, and to expose necessary techniques for successful treatment and permanent recovery from ITBFS.

ANATOMY

Examination of the anatomy begins at the hip. The iliotibial band itself is a thickened strip of fascia that provides the insertion for the tensor fascia lata and gluteus maximus muscles (1,6,7,10,19). The iliotibial band continues down the lateral side of the leg, and in conjunction with the patellar retinaculum ultimately attaches onto the lateral tibial tubercle of Gerdy (11,22). A bursa located at this attachment facilitates movement of the iliotibial band over the lateral epicondyle (6). The iliotibial band's primary function is to provide static stability to the lateral aspect of the knee (1,6,22). When the knee is flexed to an angle greater than 30 degrees, the iliotibial band shifts posteriorly behind the lateral femoral epicondyle. During knee extension, the band shifts anteriorly in front of the lateral femoral epicondyle (6,9,18). It is this motion that commonly leads to irritation and inflammation within the iliotibial band, bursa, and the periosteum of the lateral femoral epicondyle (Figure 1).

Other anatomical structures must be considered when performing an evaluation. The lateral collateral ligament lies posterior to the iliotibial band and can be easily distinguished from it by palpation with the leg in a figure-four position (9) (Figure 2). The performance of a varus stress test will aid in confirming lateral collateral ligament involvement. Lateral knee pain also may be attributed to a lateral meniscus tear. A positive McMurray's click test or any noted catching sensations might indicate meniscal involvement. The popliteus muscle originates from the lateral femoral condyle and can be palpated posterior to the lateral collateral ligament, above the joint line (9,23). It can be tested with the resistive initiation of knee flexion and tibial internal rotation (9). The biceps femoris tendon is another structure located in the region of the iliotibial band. It inserts onto the head of the fibula and is

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Figure 1. Iliotibial band motion



Figure 2. Figure-four position

easily palpated and tested with resisted knee flexion and external tibial rotation.

EVALUATION

History

Once an understanding of the anatomy is accomplished, an evaluation can be appropriately conducted. As with any

evaluation, begin with the athlete's history. A complete history should include past pathologies as well as present conditions. The type of activity, location of pain, training conditions (i.e., distances, terrain, speed), and footwear should all be noted. This syndrome is commonly seen in long distance runners, cyclists, and weight lifters (2,3,6,10,14,15,16,17,18,20). The athlete typically complains of pain on the lateral aspect of the knee just proximal to the lateral joint line (16). Affected patients will complain of increased pain with downhill, banked surface, or prolonged distance running (6,9,10,14,20). The increased length of stride with downhill running is believed to accentuate compression between the iliotibial band and the lateral epicondyle, thereby producing an inflammatory response (6,14).

Noble (14) found that 64 percent of the iliotibial band injuries studied resulted from sudden increases in distance, and 22 percent of the injuries occurred as a result of sudden increases in hill training. Lindenburg et al. (10) noted that 67 percent of the injured subjects wore rigid running shoes.

Inspection

Although training errors contribute to ITBFS, structural abnormalities also play a major role. A careful inspection will reveal these structural abnormalities. During this phase, the athlete should be wearing shorts, with shoes and socks removed. Upon inspection of lower limb alignment, the angle of the femur and the tibia should exhibit a physiological valgus of 170 to 175 degrees (23). An increase in this angle, genu varum, will often lead to ITBFS because of increased tightness across the knee joint (5,6,9,10,14,16).

Cavus feet, or excessive pronation, is documented in some patients with ITBFS (5,6,9,10,14,16). With pronation of the foot, the tibia rotates internally. This rotation brings the insertion of the iliotibial band anteromedially, tightening the band across the knee joint. Inspection of unusual shoe wear may reveal these structural abnormalities.

Also known to contribute to the incidence of ITBFS is a leg length discrepancy (6,10,16). With a lateral pelvic tilt, the iliotibial band on the longer leg may tighten and become predisposed to irritation (6).

During inspection, the examiner may note the presence of a prominent lateral femoral epicondyle (6,9,10,16). Guten et al. (3) noted the presence of osteonecrosis of the lateral femoral condyle in patients who were initially diagnosed as having ITBFS. These changes all lead to a greater chance of irritation over the lateral epicondyle (6).

Once structural abnormalities have been identified, the knee should be inspected for swelling and/or discoloration. Swelling is normally localized at the site of insertion where the bursa has become inflamed.

Palpation

The next step in a systematic process of evaluation is careful palpation. Athletes with ITBFS will exhibit extreme point tenderness two centimeters above the joint line. This pain is usually reproduced when the knee is flexed 30 degrees and palpated over the lateral femoral epicondyle (6,9,10,14,16,18). It is in this position that the iliotibial band

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lies directly over the lateral epicondyle (Figure 1). Flexion and extension of the knee may reveal a palpable creak similar to rubbing a finger on a wet balloon (9,14,18). While palpating for point tenderness, it is important to recall the location and anatomy of other structures. Care must be taken to rule out other possible knee pathologies.

Range of Motion

Range of motion evaluation should be done in weight bearing and non-weight bearing positions. Typically, the pain will be accentuated at 30 degrees of flexion, and a pop or creaking sound may be heard. Athletes will often have more pain during weight bearing flexion and extension because there is dynamic contraction of the surrounding muscles, which tightens the knee joint, possibly leading to greater irritation over the lateral epicondyle as the iliotibial band crosses it (6,9,18).

Strength

Resistive knee flexion and extension can be performed with ITBFS. A strength test will not usually reproduce the pain if the patient is non-weight bearing. However, there may be weakness in the quadriceps and hamstring muscles on the involved side as a result of pain. Strength testing also aids the evaluation by ruling out muscle involvement.

Special Tests

After strength has been assessed, three different special tests can be performed to confirm iliotibial band involvement. The Ober test is used to determine iliotibial band tightness. To perform this test, the athlete is positioned on his uninvolved side with his involved knee in 90 degrees of flexion. The athletic trainer abducts the involved leg as far as possible and extends the thigh so that it is in line with the rest of the body. Hip extension positions the iliotibial band behind the greater trochanter so that an accurate test is performed (2). The athlete is then instructed to relax; if the iliotibial band is normal, the thigh will drop into an adducted position. If the thigh remains abducted, the test is positive and a contracture of the iliotibial band can be assumed (2,4,6,10,14) (Figure 3).

Renne (18) described a test in which the athlete supports all of his weight on the affected leg with his knee in 30 to 40 degrees of flexion. The athletic trainer places his thumb over the lateral femoral epicondyle and applies pressure. At this point, the iliotibial band's posterior fibers are directly over the lateral epicondyle, and this pressure will almost always reproduce pain (Figure 4).

A similar test was described by Noble (14). The athlete is placed in a supine position and the knee is flexed to 90 degrees. Again, pressure is applied over the lateral femoral epicondyle and the knee is extended. The patient with ITBFS will complain of pain when the knee reaches 30 degrees of flexion (6,14) (Figure 5). These special tests are necessary for an accurate diagnosis.

TREATMENT

The athlete and athletic trainer must realize that this injury is a result of overuse and that time is required for

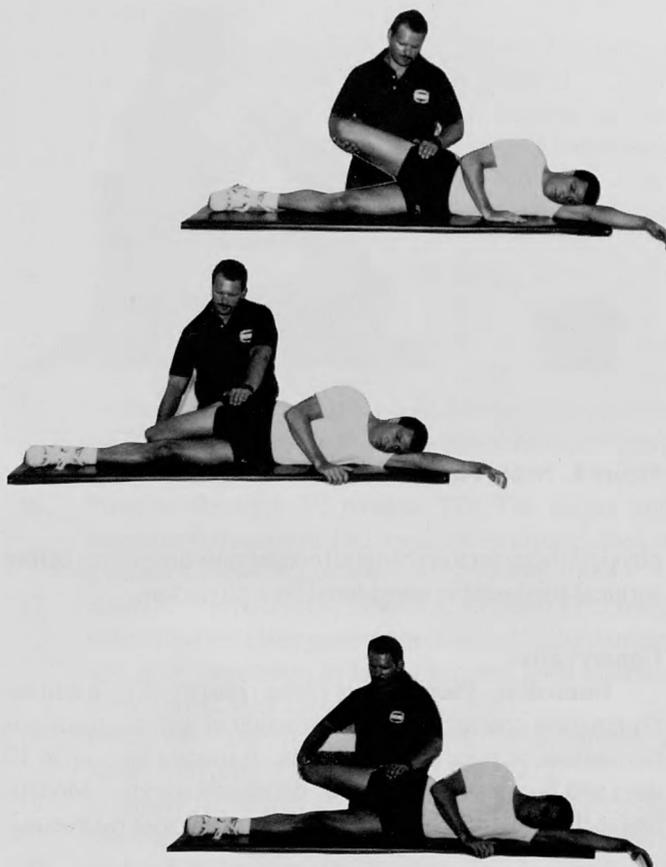


Figure 3. (From top) a) Ober test, b) negative test, c) positive test

healing to take place. Patience is essential to control frustration. A proposed treatment program can be divided into conservative or surgical methods. Within the conservative method, there are immediate, short term, and long term phases. It is common practice for the athletic trainer or

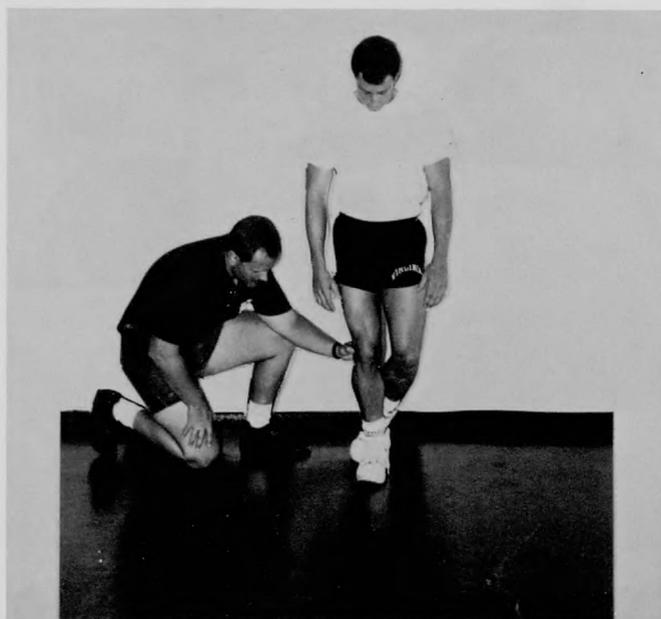


Figure 4. Renne test

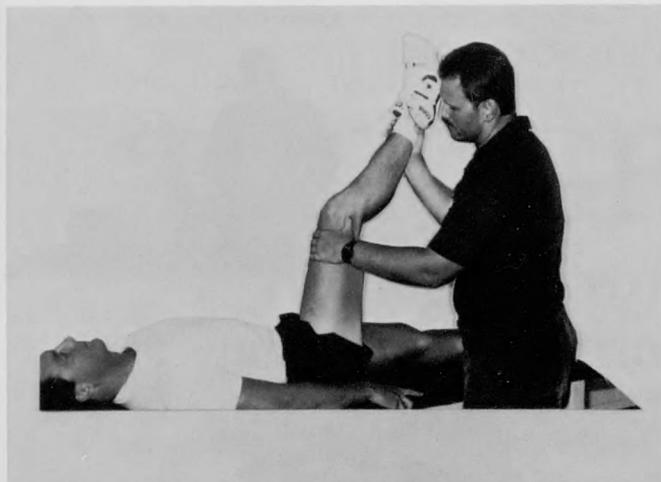


Figure 5. Noble Test

physical therapist to exhaust all conservative measures before surgical treatment is considered by a physician.

Conservative

Immediate Phase. This phase consists of pain and inflammation control, and the correction of any structural abnormalities or poor training habits. It usually lasts up to 10 days and is composed of rest or decreased activity. Modalities such as ice, heat, ultrasound, ultrasound with hydrocorti-

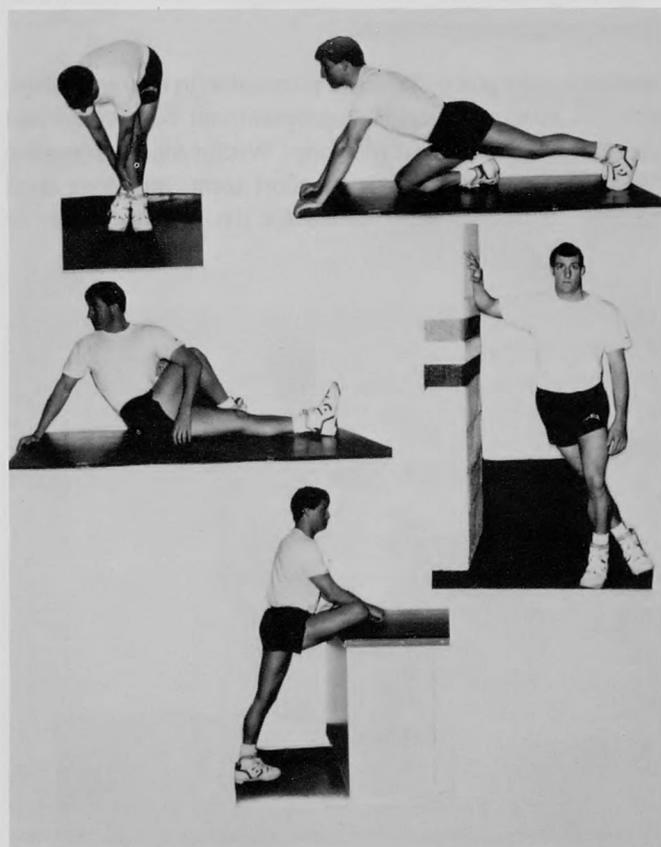


Figure 6. (Clockwise from right) a) Prone stretch, b) wall stretch, c) standing bench stretch, d) sitting lateral hip stretch, e) lateral trunk rotation and hip flexion

sone cream, or electrical stimulation may be applied. Oral anti-inflammatory medication and stretching exercises of the iliotibial band are also indicated (2). The stretching exercises involve increasing flexibility in the lateral hip muscles, hip flexor muscles, and along the lateral side of the thigh (2). Various stretching techniques for iliotibial band tightness are illustrated in Figure 6.

Prescription of foot orthoses aids in the correction of excessive pronation or cavus feet (6,9,16). In patients with leg length discrepancy, a lift is essential. A lateral heel wedge has been shown to reduce stress on the lateral aspect of the knee (16). Runners should be advised to avoid running downhill and on banked or crowned surfaces (10,14). Also, sufficient shoe support should be given to avoid complications (2,10,16).

Short-term Phase. This phase begins if relief or symptoms are not resolved in the immediate phase; it typically lasts two to eight weeks. The use of modalities and stretching should continue during this phase with the possible addition of steroid injections at the site of irritation. Injections should not exceed more than three, and should be given at two-week intervals (6,9,10,14,18). Also employed in this phase is further restriction of any activity to non-weight bearing tasks. Exercise such as straight leg raises, quadriceps setting, and isometrics can be done to minimize muscular atrophy. Cardiovascular exercise may be employed as well to minimize the loss of conditioning.

Long-term Phase. This phase begins after the pain and inflammation have subsided. It initially consists of a gradual introduction to strengthening exercises and ultimately leads to a gradual return to sport-specific activity (2,8,12,21). Ignoring this stage is a common mistake in treating this injury. Its importance must be emphasized to avoid recurrence of ITBFS (6). Noble (14) examined ITBFS in 73 cases and found that only 30 patients responded to an initial treatment. Twenty-nine patients did not respond until the second and third stages of a treatment program, and the remaining 14 patients were restricted from aggravating activity for four to six weeks.

Stretching should be continued before and after exercise. Strength training includes knee extension, knee flexion, leg press, and hip adduction exercises (2,12). Athletes should start with light weight and gradually increase the weight if pain is absent. Both concentric and eccentric work should be emphasized. A gradual return to functional activity should begin with straight forward walking. Jogging can be alternated with walking as pain allows. Once jogging begins to dominate the exercise session, walking can be terminated. The patient should increase the distance by approximately five minutes each week until 30 minutes of pain-free jogging can be achieved. Subsequently, agility exercises and sport-specific drills can be gradually introduced. This phase should last at least six weeks. At this time, if pain is non-existent, the patient may return to the previous training regimen (6).

Surgical

The surgical procedure is based on the fact that when the knee is flexed to 30 degrees, the posterior fibers of the iliotibial band ride on the lateral femoral epicondyle. The

procedure consists of a two centimeter incision releasing the posterior fibers of the iliotibial band (6,9,10,14).

Originally, excision of the lateral epicondyle prominence was performed in conjunction with the release (6,14). More recently however, success has been seen with release of the iliotibial band's posterior fibers alone. Prognosis following this surgical procedure is very encouraging. Athletes usually return to activity within two to seven weeks. Noble (14) explained that of the five patients who consented to surgery, the first patient took seven weeks to recover before returning to his previous activity. The remaining four resumed activity within two to five weeks. As with the conservative method, care must be taken to allow for a gradual return to activity.

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Tip From the Field

Student Athletic Trainer On-Call

Neal S. Dutton, MS, ATC

In order to better care for athletes, we have initiated an on-call program with the student athletic trainers. Throughout the semester, all student athletic trainers are assigned a weekend during which they will be on-call to care for injured athletes. The purpose of this program is to make the services of the training room available to athletes during non-training room hours. During this time, basic treatment and first aid such as ice, dressings, and analgesics are provided, within the limitations of the student athletic trainer. The service also allows those athletes who have had more significant or undetected injuries to reach a training staff member. The student athletic trainer is then able to direct the athlete to appropriate medical care personnel.

The on-call student athletic trainer's name and phone number are posted on the training room door following the Saturday morning activities. From then until Monday morning, the on-call student athletic trainer is available. The student athletic trainer is also responsible for opening the training room on Sunday afternoon, so that injured athletes may get an early start on their treatments.

Originally, the student athletic trainers were required to be available at the phone number posted on the training room door. However, this created a problem for those who wished to study in the library or student center, or visit friends. The solution was a display type pocket pager. Since our college uses a large number of these pagers, we were able to lease one for the training room for about fourteen dollars per month. Now, the student athletic trainer on-call can be reached anywhere in the Metro area. The athletes just touch in their phone numbers, which are then displayed on the pager, and the student athletic trainer can call within a few minutes. A

boundary of fifteen minutes from the college has been established to keep the athletic trainer relatively close to campus.

In order to limit false alarms or "crank pages," we have stressed the importance of keeping the phone number of the pager confidential among athletes and student athletic trainers. The phone number of the pager is given only to athletes at the beginning of their season. This service is provided for the athletes, and they seem to understand that it cannot be abused. It is also important that athletes and student athletic trainers understand that in the case of a perceived emergency, the EMS system must be activated immediately.

There is an added bonus to having the pager. The pager can be used to communicate between the training room and the head athletic trainer if he/she is away from the training room (1). This can be especially helpful when sports seasons overlap and teams are scattered throughout the campus. For example, I wear the pager while on the football field. This enables the student athletic trainers working with other teams to reach me quickly in case of an emergency. The phone number of the facility where the student athletic trainer is working is displayed on the pager. I either call from the press-box or go directly to that facility. This can save valuable time. During the rest of the week, I wear the pager so the student athletic trainers can reach me easily.

We believe that the student athletic trainer on-call program, and the institution of the pocket pager have improved the quality of care that our athletes receive. They not only enable the athletic training staff to be more accessible to the athletes, but they can also dramatically reduce emergency response times. Perhaps a similar program would benefit your organization.

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Student Athletic Trainer Forum

Deloss Brubaker, EdD, ATC

Injuries to C₁ - C₂ Vertebrae in Sports: A Discussion and Case Study

Amy Faber, ATC

ABSTRACT: An injury to the upper level of the cervical vertebrae can occur in sports. Therefore, it is necessary for athletic trainers to be cognizant of the anatomy, stabilizing ligaments, management techniques and, if the potential exists, different protocols for a return to a sports environment following an injury of this type. A discussion and case study on C₁ - C₂ injuries in sports is presented. Research completed on injuries to this level of vertebrae has previously focused on injuries resulting from non-sports related accidents.

The incidence of injury to C₁ and C₂ vertebrae in sports is rare (6). Several published articles have reported C₁-C₂ injuries occurring during vehicular accidents or other non-sports related activities (1,3,4). Very few published findings, however, report management protocols and recovery rates from athletic injuries of this nature. Tator (5) studied 42 major neck injuries in hockey, and reported that injuries to C₁ - C₂ are infrequently encountered.

As athletic trainers, it is not only important to be aware of how injuries of this type occur, but also how they affect daily living and the potential for return to athletic competition subsequent to rehabilitation. This case study, therefore, provides insights into C₁ - C₂ vertebral injury in sport. Further, it is hoped that this study will shed an optimistic light on the management of this serious trauma.

ANATOMY OF THE ATLAS AND AXIS

Adelstein (1) states that it is essential to understand the anatomy of the first two cervical vertebrae if the type or extent

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of an injury to this area is to be understood. The atlas and axis are atypical vertebrae. Their specific designs and complex structure allow for more range of motion in the movements of cervical flexion/extension and rotation than occur anywhere else in the cervical spine.

The atlas is a thin, ring-shaped vertebra and contains no pedicles, laminae, or bodies. The large superior articulating facets allow a rolling and gliding motion to occur with the occiput. This motion accounts for 50% of the flexion and extension that is found at the neck. The two inferior facets articulate with the axis along with a third facet, which is located on the posterior surface of the anterior ring and articulates precisely with the odontoid process (1,6).

The axis is the largest and thickest cervical vertebra (1). The upward projecting odontoid process or dens attributes a unique property to this vertebra. The dens, embryologically, is the body of the axis. This special atlanto-axial articulation allows for 50% of the cervical rotation (1,6).

The stability at the C₁ - C₂ is attributed mainly to the alar and transverse ligaments. The alar ligament limits rotation and runs from the superior lateral aspect of the tip of the dens to the occipital condyles. The transverse ligament holds the dens against the interior arch of the atlas. It originates at the posterior ring of the atlas and runs transversely across the odontoid. Four other ligaments limit flexion and/or extension and are continuations of the longitudinal tract system. They include the anterior and posterior atlanto-axial ligament, the tectorial membrane, and the ligamentum nuchae (1,6).

LIGAMENOUS INSTABILITY

Injury to the neck, with or without fracture, can cause an irreversible stretch or rupture of any of the ligaments in the atlanto-axial complex resulting in instability (7). Dvorak, Hayek, and Zehnder (4) studied 43 victims of C₁ - C₂ injuries resulting from vehicular accidents. They concluded that a rupture to the alar ligament can increase rotation at the atlanto-occipital and atlanto-axial joints by an average of nine degrees to the side opposite the rupture. Torg (7) states that with a rupture of the transverse ligament, along with the alar

ligament, an anterior translation of $C_1 - C_2$ may result with the spinal cord being pinched between the dens and the anterior arch of the atlas.

Earlier studies have revealed that collagen fibers making up the alar and transverse ligaments can be stretched only ten to twenty percent of their original length before rupture or other irreversible damage occurs (4). The severity of the damage to these ligaments is further supported by Torg (8) who explains that in cervical injuries that cause tissue disruption, an instability will likely develop despite conservative treatment.

DIAGNOSTIC EXAMINATION

In athletes, it is important to rule out instability when significant injuries to the cervical region occur. Undetected instability may result in neuropraxia to the cervical spinal cord, transient paralysis (8), permanent paralysis, or possibly death. Plain radiographic studies reveal instabilities of the atlas and axis (3,6,8). Anterior/posterior open mouth projections are taken to view the odontoid process in relation to C_1 ; and lateral views are taken to check normal alignment of all the vertebrae. Active flexion/extension films allow determination of ligamentous disruption during motion (8).

The use of computerized tomography (CT) scans and magnetic resonance imaging (MRI) enable viewing of portions of the vertebrae which cannot be assessed in regular roentgenograms. CT scans display a cross section of the vertebrae, which helps to determine problems of the bony structures including the size and integrity of the spinal canal (6). MRI shows the integrity of both the soft tissue and, possibly, the bony structure.

With the use of these diagnostic tools, cervical injuries can be classified according to injury level and area of fracture of the cervical vertebrae. Adelstein (1), Beatson (2), and Torg (6) have written about the classification of injuries to the upper cervical spine.

MECHANISMS OF INJURY

The mechanisms of injury known to cause disruption to the atlas occur from vertical compression and hyperextension (1,9). Specific injuries to the axis may result from head impact, although literature explains that specific mechanisms of injury to the odontoid process are not clearly understood. Most literature describes the mechanism as occurring from head impact, or possibly from an array of forces occurring at one time (1).

MANAGEMENT

Injuries involving $C_1 - C_2$ can be treated conservatively; although, as stated previously, once soft-tissue disruption occurs, it is probable that an instability will develop. A conservative treatment for acute cervical spinal injuries may involve wearing a halo brace (3). However, once stabilization is discontinued, if hypermobility, pain, and other clinical signs still remain, surgical stabilization is recommended. Posterior fusion or a screw fixation transpedically may be

used (4). In most instances, recognition of early instability will call for this form of acute management.

Protocol allowing for the return to sports after an athlete sustains an injury to the cervical spine is reported by Torg (7). An athlete whose injury of the cervical region did not involve an instability or fracture, may eventually return to all types of sports provided that all neurological, sensory, and motor signs are normal.

For an athlete who has subluxed a vertebra and has not undergone a stabilization process to correct the instability, a return to contact sports is contraindicated. This theory has been supported by Dvorak, Hayek, and Zehnder (4) who found significant instabilities at the atlanto-axial joint in individuals who had suffered trauma to the spine.

The situation in this case study consists of a one level stabilization process involving a posterior fusion of the first two cervical vertebrae. Torg (7) states that based on clinical experience, if a one level stabilization has been successful and the athlete has a full range of motion and strength, he or she may eventually return to contact or collision type pursuits.

PRESENTATION OF CASE

A 17 year-old male hockey player was knocked head first into the boards during a game on December 16, 1988. The athlete was unconscious for a five to ten second period, and upon awakening complained of pain in the neck. He also reported a loss of sensation from the neck down, probably lasting about five seconds. To avoid further injury, his neck was stabilized using a cervical collar and backboard. The athlete was then transported by ambulance to a nearby hospital where a fracture of the anterior ring of C_1 and a Type II odontoid fracture were found. All neurologic, sensory, and motor responses were normal.

One week later on December 22, 1988, the fracture was stabilized by a posterior fusion of $C_1 - C_2$ using wire and an iliac crest bone graft. The athlete was placed in a halo brace to maintain immobilization. X-rays taken of the cervical spine the day following surgery showed normal alignment of the vertebrae.

Approximately three and one-half weeks following surgery, the athlete was discharged. The halo brace remained in place for 11 weeks and was removed in the middle of March 1989. A soft collar replaced the brace for two to three more weeks.

In July of 1989, the scar was healing well and no significant atrophy of the cervical or shoulder muscles was found. The athlete had no complaints of pain or point tenderness in the cervical region. Active range of motion tests revealed limited rotation mainly to the right, and lateral flexion limited slightly more on the left. When muscle testing the myotomes $C_2 - T_1$ manually, strength was found to be equal bilaterally, and no obvious weaknesses were noted.

Rehabilitation was begun on July 6 with the ultimate goal of reaching normal strength and range of motion. Manual resistance was used for strengthening the cervical musculature in all motions concentrating the most on rotation and

lateral flexion. Eventually, the athlete was able to use Nautilus neck strengthening machines for lateral flexion and extension.

In September of 1989, a follow-up by a doctor other than the physician who performed the surgery revealed a well healing fracture and bone graft stabilization. The doctor informed the athlete of possible problems and the increased chance of cervical spine injury with participation in contact sports. With statements from the athlete and his parents saying that they understood the possible outcomes of participation, he was able to play hockey in the fall of 1989.

He completed the season with no pain or problems of his cervical spine.

CONCLUSION

Based upon the findings documented in this case study, and within the limitations of this report, the following information becomes evident. Research completed on the atlanto-axial complex has been concentrated on injuries resulting from vehicular accidents or other non-sports related activities. It is important to note that the mechanism of injury in those situations does not involve the same type of forces or contact that may cause the same form of injury to an athlete. For this reason, case studies of athletic injuries to this area are important for further research on C₁ - C₂ in sport.

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Glenohumeral Dislocations: Evaluation, Treatment, Rehabilitation

Deborah Mormann, ATC

ABSTRACT: Shoulder dislocations occur often in contact sports. The most common is the anterior dislocation of which there are two types: the atraumatic and the traumatic. When evaluating a dislocation, the signs and symptoms of the anterior dislocation are much more easily noticed than the subtle signs of the posterior dislocation. The history, including a mechanism of injury, plus a thorough evaluation of the shoulder girdle, should lead to a correct prognosis. Reduction is one of the most important aspects of treatment of the shoulder dislocation. There are several recommended ways to reduce a shoulder: Hippocratic Method, Modified Hippocratic Method, Kocher's Method, Stimson Method, Milch Method, and the Passive Method. Controversy exists as to how long a shoulder should be immobilized; it is suggested that three weeks is the optimum time for immobilization. Rehabilitation is divided into two phases: the acute rehabilitative phase, and the post-acute phase. There are different methods proposed for rehabilitation, some use more isotonic exercises whereas others use more isokinetic exercises. In both methods, plyometric and sport-specific exercises are incorporated. The athletic trainer must be aware of the likelihood of recurrence and of the surgical techniques available for correcting this problem.

Shoulder dislocations account for up to 50% of all dislocations. The most common is the glenohumeral dislocation, specifically the anterior glenohumeral dislocation. A posterior dislocation is a rare lesion in the athlete, accounting for less than 2% of shoulder dislocations (9).

There are two basic types of anterior glenohumeral dislocations: the atraumatic and the traumatic.

The atraumatic is seen in the hypermobile, loose-jointed person and is commonly associated with an emotional problem. The person may sublux or dislocate either shoulder at

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will. This type of dislocation is rarely seen in athletes. Treatment of such a person with an anterior surgical repair may result in recurrence of the dislocation either anteriorly or posteriorly (6).

Traumatic dislocations result from a substantial degree of trauma. The instability which occurs is characterized by being uni-directional, but may be multi-directional. Traumatic dislocations account for approximately 95% of all anterior dislocations (7).

EVALUATION

Evaluating an anterior shoulder dislocation is usually easy except in situations where the individual is obese or heavily muscled. A posterior dislocation is much harder to evaluate and may even be missed on the initial examination.

Signs and symptoms of an anterior shoulder dislocation are as follows. Typically the athlete is in severe pain and tries to prevent any motion of the injured shoulder by supporting it with the other arm. The athlete frequently realizes that "something is out of place." The affected shoulder is usually in an externally rotated position, and any attempt to rotate the shoulder internally will be unsuccessful.

The physical findings of the anterior dislocation are usually consistent. The dislocated shoulder is characterized by a prominent lateral acromion, and a cavity may be palpated below it where the humeral head is located. The normal contour of the deltoid looks flattened and a fullness, which may not be visible, may be felt on palpation. Sensation in the arm may be diminished because of injuries involving the brachial plexus or peripheral nerves (especially the axillary nerves).

The mechanism of injury in anterior dislocation is a combination of abduction, elevation, and external rotation of the humerus on the glenoid. Dislocations may occur as a result of direct and indirect forces. A direct blow to the posterior or posterolateral aspect of the glenoid cavity is a common cause of dislocation.

Signs and symptoms of a posterior dislocation are much more subtle than those of an anterior dislocation. Symptoms consist of generalized shoulder pain and inability to externally rotate or abduct the arm. In contrast to the anterior dislocation, the athlete with a posterior dislocation might not realize that his shoulder is actually dislocated.

One of the physical findings is that the coracoid process

is prominent. Also, the anterior aspect of the humeral head is less prominent than that of the opposite shoulder, and may be palpated posterior to the acromion. The long axis of the humerus appears to be normal, but movement through the normal range of motion is painful, and abduction is restricted.

The mechanism of injury is glenohumeral joint adduction and internal rotation at the time of injury. This usually happens from a force which drives the humeral head backward while the arm is flexed (usually below 90 degrees) and internally rotated.

When evaluating a dislocation, a brief history of how the accident happened should be obtained. The history plus a thorough evaluation of the shoulder girdle should lead to a correct prognosis. It should be pointed out that other problems, such as acromioclavicular (AC) separations, may occur concomitantly with dislocations of the glenohumeral joint (6). X-rays should be obtained to confirm the initial evaluation and rule out associated fractures.

TREATMENT

One of the most important aspects of treatment is the reduction of the dislocated shoulder. Reduction should be done by a physician as soon as possible. If reduction is delayed, it may become more difficult because muscle spasm of the surrounding musculature occurs within minutes of the dislocation. The shoulder should be reduced with as little additional trauma as possible in order to prevent fractures, or damage to the articular surface and the neurovascular structures.

Once the patient is adequately relaxed, there are several methods proposed to reduce the shoulder.

1. Hippocratic Method. The patient lies supine, and the physician pulls the patient's wrist against counter-traction created by the physician's bare foot in the axilla or against the chest wall. It is possible to injure the neurovascular components of the axillary fossa with this maneuver (6,9).

2. Modified Hippocratic Method. The patient lies supine. The arm is held at between 30 to 45 degrees of abduction. Counter-traction is applied by means of a sheet around the upper thorax, the pull being in the opposite direction to the traction on the affected arm. The affected arm is very gently pulled in its longitudinal axis, while the patient is reassured and encouraged to relax. The traction should be gentle, with a slow increase in the amount of force exerted. It should be steady, and held for approximately sixty seconds. In most cases, the arm will be felt to slip back into the glenoid fossa as the athlete relaxes. The arm should then be turned into internal rotation and held in place across the chest (5,9).

3. Kocher's Method. The patient lies supine. With the elbow flexed at 90 degrees, the physician applies traction to the humeral shaft and gently externally rotates the arm. If reduction does not occur, the elbow is brought in front of the chest to bring the humeral head into place. Care must be taken not to fracture the humerus with this method (5,6,9).

4. Stimson Method. The patient lies prone. The dislocated shoulder hangs over the edge of the table and the hand hangs free above the floor. Weight is added to the hand to help gentle reduction occur with a minimum of complications (6).

5. Milch Method. The patient lies supine. The physician places his hand over the top of the shoulder or acromion and his thumb in the axilla supporting the dislocated head. The head is then flexed by the thumb as the physician's other hand gently abducts and externally rotates the arm overhead. When the arm reaches complete abduction, the head is gently pushed over the glenoid rim into place (6).

6. Passive Method. The patient sits on a stool and is encouraged to relax the trapezius muscles, and to keep the shoulders horizontal. The physician supports the elbow on the affected side and has the patient abduct the whole arm above the horizontal plane. The patient then externally rotates the forearm to a position behind the ear. The arm is then adducted while maintaining external rotation. After the arm is completely adducted, it is internally rotated. The shoulder will occasionally reduce on external rotation, but more often, it reduces during either adduction or internal rotation of the arm (2).

Some factors will prevent reduction of dislocation including biceps tendon interposition, glenoid locking in a humeral head defect, and rotator cuff interposition. Repeated closed manipulations should be done only by an orthopedic surgeon after obtaining adequate x-rays and administering anesthesia (6).

There are many possible complications which might occur from reducing a dislocated shoulder. It is possible to fracture the humeral head and/or glenoid, sustain epiphyseal damage (5,6,9), damage one or more of the underlying nerves (5,6,9), tear the rotator cuff (5,6), or cause axillary damage (5,9).

After reduction, the shoulder should be immobilized in adduction and internal rotation. Controversy exists as to how long it should be immobilized. Many authors suggest three weeks as the optimum time for immobilization (1,5,6,9). However, Henry (1982) suggested after performing a study on patients with acute traumatic anterior dislocations, that immobilization of the shoulder made no significant difference in the prognosis of recurrence. He felt that there was no correlation between either immobilization or length of immobilization, and the time lapse to the second episode or recurrence. In a later article, Henry (1984) does point out more specific guidelines for his theory. He feels that in patients over 30 years of age, shoulders should be immobilized for one week just for relief of pain from stiffness. For patients under age 30, he recommends three weeks, but feels that this is just for relief of pain and not to deter recurrence.

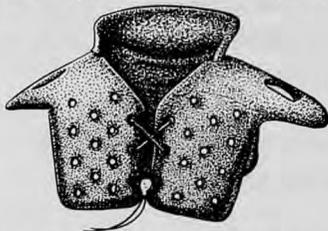
REHABILITATION

Rehabilitation of shoulder dislocations can be divided into two phases: the acute rehabilitative phase and the post-acute rehabilitative phase.

Acute Rehabilitative Phase. Protection and rest are generally accomplished through immobilization. Applying ice helps to decrease pain, swelling, and muscle spasm. Isometric exercises are the first type of exercise started. Grana (1987) suggested that they should be initiated as soon as possible to maintain muscle function. Whereas Aronen (1984) feels that three weeks of rest and immobilization

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Totally new in concept and design, the Cowboy Collar is worn as regular equipment or as protection after an injury. It's the only product that incorporates a molded collar of resilient, closed-cell, polyethylene foam with a padded, protective vest. The Cowboy Collar was developed jointly by Jeffrey D. Fair, Ed.D., ATC, Head Athletic Trainer at Oklahoma State University, and McDavid Sports Medical Products of Illinois.

The Cowboy Collar's unique design absorbs shock by cupping the sides and back of a player's helmet. This provides a cantilever effect by firmly supporting the helmet inside the collar, reducing the angle of flexion of the neck. The result is less restriction and better control of hyperextension and extreme lateral movement of the head.

Ultra-lightweight, yet durable, the Cowboy Collar simply spring loads into most standard shoulder pads and stays in place with minimal shifting. Its molded, one piece construction is almost totally non-restrictive, providing more freedom of movement. The Collar is available in sizes Regular (14½"-16½" neck) and Large (16½"-19" neck).

Protection Breakthrough

Through the 1989 football season, Cowboy Collar developer Jeff Fair conducted a study at Oklahoma State University to determine the Collar's effectiveness.

Selected linebackers were required to wear the Cowboy Collar, since OSU data indicated that linebackers were the most likely to sustain neck injuries.

At the study's end, none of the linebackers fitted with a Cowboy Collar had suffered a brachial plexus injury, while twelve players at other positions had. After being fitted with Cowboy Collars, only three of these twelve players had mild recurrences of their injuries.

"Our data suggests that the Cowboy Collar is most effective when used as preventive equipment," said Fair, "and that the Collar helps prevent further, more severe injury when worn after an initial injury."

None of the players fitted with a Cowboy Collar sustained a shoulder injury, either. And most players who wore the Collar liked it. "We found that the Collar was somewhat of a teaching aid," Fair noted. "Players would bring their heads up until they felt the Collar's support, to make sure they were

properly positioned."

"From our study, it appears that the Cowboy Collar is clearly a step in the right direction in reducing injuries in an injury-plagued sport," concluded Fair.

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should pass before isometrics are begun.

Exercises should include isometric contractions of the anterior deltoid, middle deltoid, posterior deltoid, pectoralis major, internal and external rotators, scapular elevators, adductors, and depressors. While the shoulder is immobilized, the patient should work on range of motion exercises of the elbow, wrist, and hand. Strengthening exercises for the hand and forearm should also be initiated. Aronen (1984) feels that the patient should progress to isotonic exercises utilizing surgical tubing for internal rotation and adduction.

Post-Acute Rehabilitation Phase. After immobilization, Grana (1987) recommends active range of motion exercise with the patient lying in a gravity-eliminated position. Shoulder flexion and abduction are limited to 90 degrees, and external rotation is limited to neutral for three additional weeks in order to minimize stretching of the anterior joint capsule. He also recommends Codman's exercises be used to help increase active range of motion and to stimulate contraction of the rotator cuff muscles.

When the patient regains muscle function, coordination, and strength in a gravity-eliminated position, active range of motion exercises against the force of gravity should begin. Later, Grana (1987) suggests that when the patient is able to move the arm through 90 degrees of flexion and 90 degrees of abduction without pain, resistive weighted exercises should begin. Progressive resistance exercises use dumbbell weights and are designed to include the entire upper extremity. Once the patient has achieved an adequate range of motion, which is sufficient for proper positioning, weight machines may be used for increased resistance.

Aronen and Regan (1984) promote a program of rehabilitation which incorporates much more isokinetics. At three weeks, they feel that the patient is ready for internal rotation and adduction on isokinetic equipment. The exercises are performed at speeds of 180 degrees per second and higher, in accordance with the patient's capability to obtain and maintain resistance. Later, Aronen's (1984) patients progress to a complete shoulder rehabilitation session in isokinetics. These exercises include internal and external rotation, flexion, extension, adduction, and abduction. Once it is determined from an isokinetic test (Cybex II+ test) that the patient has received the maximum benefit from the isokinetic sessions, then the patient is instructed to perform isotonic exercises on his own.

As the patient progresses through rehabilitation in both of the methods discussed, plyometric and sports-specific exercises are incorporated into the treatment program to help prepare the patient for a safe return to normal activity. Plyometric exercises for the upper extremities may include playing catch with a medicine ball and throwing it overhead. Sport-specific exercises may include using a weighted object to go through a particular pattern. Examples of this are swinging a weighted baseball bat or tennis racquet, or for swimmers, cautiously using special hand paddles. Cardiovascular fitness will have to be maintained throughout the rehabilitative process as the patient progresses.

RECURRENT DISLOCATIONS

Studies of adolescent and young adult males sustaining primary anterior shoulder dislocations reveal the likelihood of recurrence to be above 50% and as high as 79 to 94% (1). The majority of all dislocations occurring before the age of 20 eventually become recurrent without regard to the time or type of care provided to the primary injury (7). The second dislocation usually follows within 18 months, but may not occur for up to five years.

The exact cause of the recurrence has not been defined. Theories brought forth in the literature include laxity of the subscapularis muscle (3,4,8), injury to the anterior glenoid and its labrum (Bankhart Lesion) (3,8), stretching of the anterior capsule (3,8), and a defect in a portion of the humeral head (Hill-Sachs Lesion) (3,8).

Braly's (1985) study points out that the Bankhart lesion probably accounts for the majority of shoulders with recurrent anterior dislocation and subluxation.

SURGICAL TECHNIQUES USED

The most common operations used are the Putti-Platt, Bankhart, Bristow, and Magnuson-Stack procedures.

Studies have shown the benefit of using the Putti-Platt procedure alone or in combination with the Bankhart procedure (4). The Putti-Platt procedure attempts to directly shorten both the subscapularis tendon and the anterior joint capsule. The additional Bankhart procedure is a staple capsulography to repair a glenoid tear. The average result of using this type of repair is a 7 to 19% redislocation rate and an average restriction in range of motion of 20 degrees in external rotation (4). Collins concludes in his study, that given the theoretical basis for the operation, it seems logical that the redislocation rate will increase as the average loss of range of movement decreases.

The Bristow procedure is another popular method used to repair a dislocation. This procedure calls for transferring the tip of the coracoid, with its attached tendon, to the glenoid rim. This is done by making a "T" incision in the shoulder capsule. The average range of motion lost following surgery is 10.3 degrees (3) in external rotation. There is no data as to the recurrence of dislocation because the number of patients who have undergone the modification is relatively small, and in some, the follow-up period is limited. Absolute conclusions, therefore, cannot be made (3).

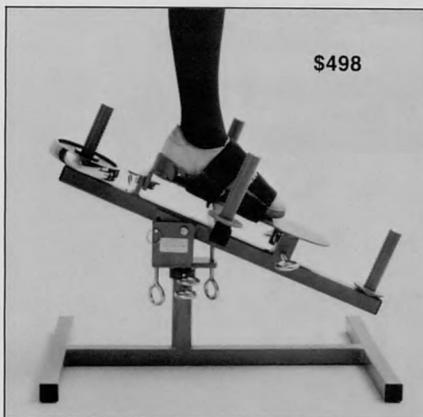
The Magnuson-Stack procedure was developed in 1943 and has been a popular surgical method used for anterior glenohumeral dislocations. In this procedure, the subscapularis muscle tendon is transferred laterally to the greater tuberosity, and then distally approximately 1 cm. A bone staple is then used for osseous fixation. Results of using this procedure show a loss of ten degrees of the range of motion with a hand-held goniometer. A testing of the range of motion with a Cybex II+ noted a loss of 25 degrees of external rotation. Postoperatively, 85% of these patients' shoulders did not dislocate again (8).

The procedure performed should be selected based on

the pathology found at the operation. The athletic trainer should be aware that the patients are prohibited from contact sports and vigorous overhead activities for three months postoperatively.

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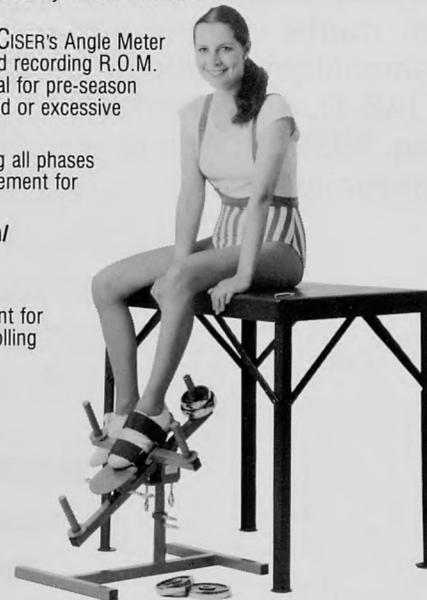
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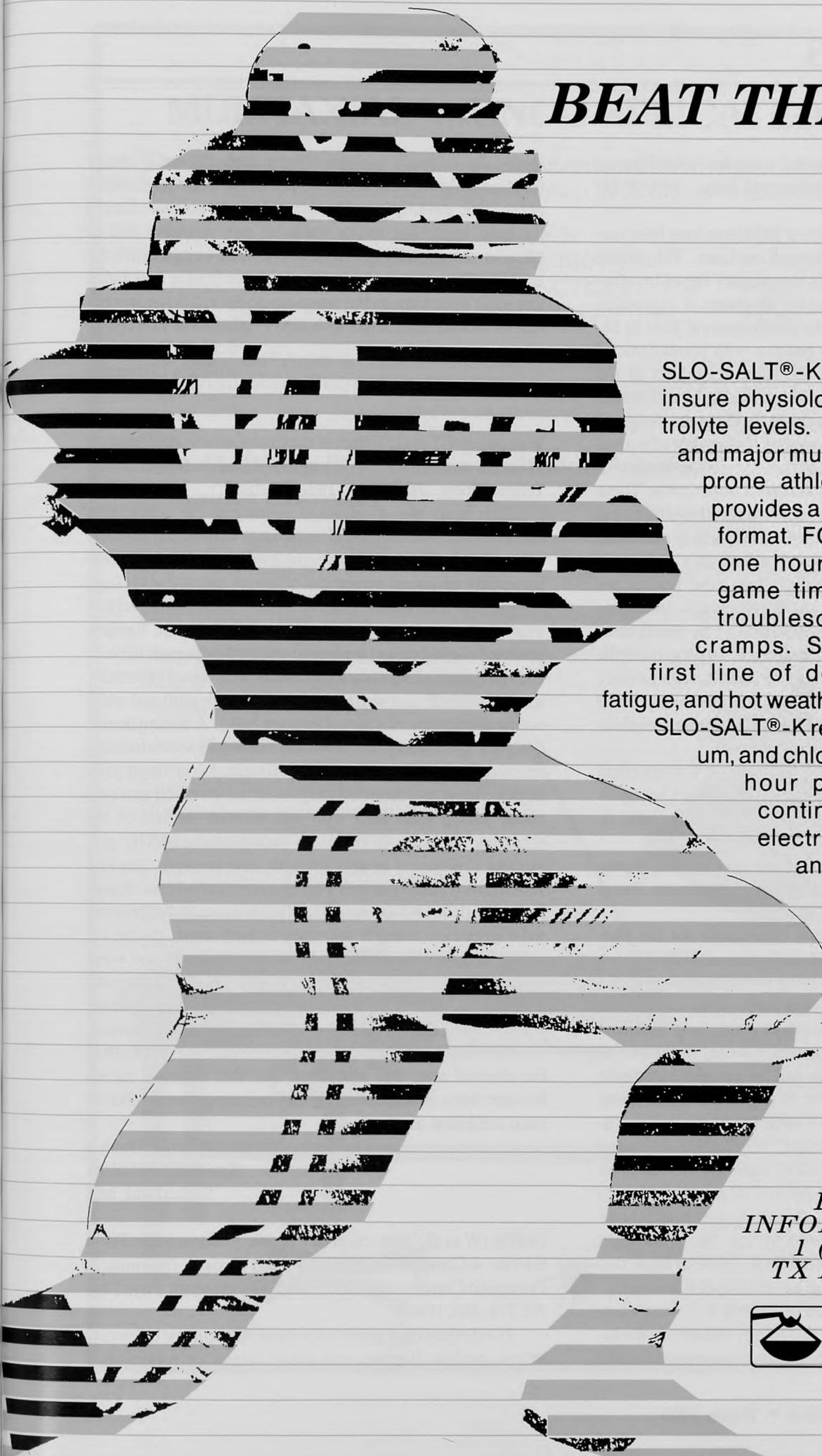
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Abstracts

Woodall W et al.: A Biomechanical Basis for Rehabilitation Programs Involving the Patellofemoral Joint. *JOSPT* 11: 535-542, 1990.

Problems at the patellofemoral joint have long been recognized as a cause of dysfunction of the knee. This is true when the patellofemoral joint is the primary site of involvement, and when the injury to other structures or aggressive activity/rehabilitation causes the patellofemoral joint to become involved. All too often patients with patellofemoral joint involvement are treated the same regardless of the underlying pathology. This article reviews the biomechanics of the patellofemoral joint in order to facilitate the design of safe, effective rehabilitation programs. The review of normal patellofemoral biomechanics is followed by general rehabilitation guidelines based on those normal biomechanics. These guidelines can be used to design individualized rehabilitation programs for patients with patellofemoral joint dysfunction, in place of putting all patellofemoral patients on a straight leg program regardless of pathology. Two case studies are presented. These incorporate the rehabilitation guidelines that were based on normal biomechanics of the patellofemoral joint. The information presented can help the therapist plan a safe and effective treatment for patients with primary involvement of their patellofemoral joint, and help prevent negatively involving the patellofemoral joint when rehabilitating other lower extremity pathologies.

Scott T. Doberstein
Millikin University
Decatur, IL

High DM et al.: The Effects of Static Stretching and Warm-up on Prevention of Delayed-Onset Muscle Soreness. *Res Q Exer Sport* 60: 357-361, 1989.

The underlying mechanisms responsible for the phenomenon of Delayed-Onset Muscle Soreness (DOMS) have been investigated, yet the underlying pathophysiology is still unclear. DOMS has been related to possible tears in the muscle tissue, damage to connective tissue, and localized muscle spasms. It has been suggested in the lay literature that static stretching and/or warm-up will prevent the occurrence of DOMS. The primary purpose of this study was to determine whether or not preexercise static stretching and warm-up affect the level of pain associated with DOMS following exhaustive exercise. The method of inducing DOMS in 62 volunteers was a step test. As expected, all groups and sexes performing the step test had significantly higher muscle soreness in the left (eccentrically worked) leg than in the right (concentrically worked) leg. This study failed to show that static stretching and/or warm-up before exercise have a significant effect on the perception of DOMS following exercise. Possible explanations for this failure include: 1) the intensity or duration of the stretching or warm-up exercises was

inadequate to evoke positive effects; 2) the intensity and/or duration of the step test was too great for any beneficial effects of the static stretching and/or warm-up to be measured; or 3) the static stretching and/or warm-up may not have had an effect on the underlying mechanisms that are responsible for DOMS. Thus, within the limits of this study, it is concluded that static stretching and/or warm-up do not aid in the prevention of DOMS associated with heavy exhaustive exercise.

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Wadsworth CT et al.: Effect of the Counterforce Armband on Wrist Extension and Grip Strength and Pain in Subjects with Tennis Elbow. *JOSPT* 11: 192-197, 1989.

This study was designed to investigate the effects of a lateral counterforce armband on patients with lateral humeral epicondylitis. Subjects were eight females and six males experiencing unilateral symptoms of lateral epicondylitis for a minimum of four weeks. Passive wrist flexion and/or resisted wrist extension with the elbow extended and the forearm pronated elicited pain at the lateral epicondyle in each subject. Using a dynamometer, each participant was tested bilaterally for grip strength and wrist extension strength with and without the application of a lateral forearm band. A testing device designed specifically for this study stabilized the extremity, isolated the muscles tested, and maintained consistent joint angles. Subjects quantified the pain in the involved arm on a visual analog scale both with and without the use of the armband. In order to eliminate problems created by pre-existing differences in arm strength, raw strength data and visual analog pain measures were converted to percent change for comparison. While use of the armband resulted in grip and wrist extension strength increases in both arms, its use resulted in a significant increase in grip strength and wrist extensor strength in the affected arm only. While pain tended to decrease, no significant decrease occurred during either strength test. The authors concluded that the lateral counterforce armband increases wrist extension and grip strength in the affected arm, and postulated that this increase occurs because stress is dispersed, thereby reducing trauma and related inhibition mechanisms.

Jennifer Donner
Springfield College
Springfield, MA

Griffin JW et al.: Reduction of Chronic Posttraumatic Hand Edema: A Comparison of High Pulsed Current, Intermittent Pneumatic Compression, and Placebo Treatments. *Phys Ther* 70: 279-286, 1990.

Hand edema that persists for weeks after upper extremity trauma such as fracture, soft tissue injury, or surgery is a

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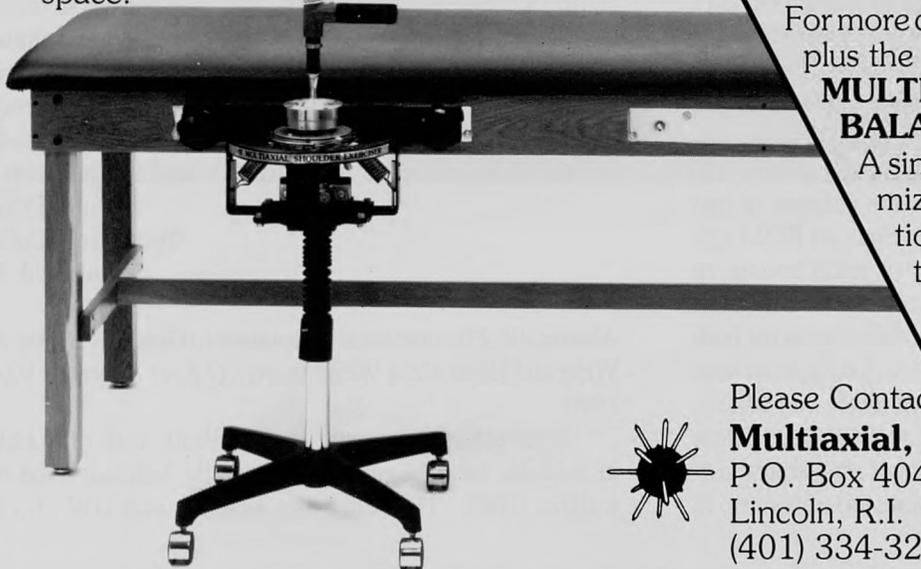
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problem in rehabilitation. Chronic hand edema contributes to pain, decreased active motion, and further edema. Traditional methods of minimizing edema immediately following trauma include elevation, use of external compression wraps, cold application, and active motion of adjacent, unaffected parts. Adjunctive methods such as high voltage pulsed current (HVPC) stimulation and application of intermittent pneumatic compression (IPC) are also commonly used for edema reduction. Physiologic mechanisms by which reduction of edema can be accomplished include increased lymphatic flow, increased venous drainage, and improved blood flow in the limb. Considerable scientific evidence from animal and human investigation indicates that both IPC and electrical stimulation can produce these physiologic effects. The purpose of this study was to compare the efficacy of IPC and HVPC in reducing chronic posttraumatic hand edema. Thirty patients with posttraumatic hand edema were randomly assigned to IPC, HVPC, or placebo-HVPC groups (10 patients in each group). Reduction in hand edema was significant between the IPC and placebo-HVPC groups ($p=.01$). Differences in edema reduction between the IPC and placebo-HVPC groups did not reach statistical significance ($p=.04$), but were considered clinically significant. There was no significant difference between the IPC and HVPC groups.

Scott T. Doberstein
Millikin University
Decatur, IL

Green TA et al.: Bilateral Inversion - Eversion Range of Motion Comparisons among College Athletes. *JOSPT* 11: 543-546, 1990.

Injuries to the ankle joint are prevalent in athletics, accounting for approximately 15 percent of all sports injuries. The most common injury is an inversion sprain whereby the foot rolls onto the lateral border stressing the three lateral ligamentous structures. Physical therapists, athletic trainers, and other rehabilitation personnel often play an important role in the management of acute, lateral ligamentous sprains, as many of these injuries are treated conservatively. An important component of an initial physical therapy ankle evaluation is the assessment of passive range of motion (ROM). The passive testing assists in determining the extent of ankle deficit, and is also important in establishing an appropriate treatment plan and assessing an individual's ability to return to activity. The use of these procedures requires that the non-injured contralateral ankle be subjected to the same examination for reasons of comparison. Thus, the purpose of this study was to compare passive inversion-eversion ROM values of individuals with no prior history of ankle trauma, to determine if side to side difference existed. The results of this study demonstrated significant bilateral differences for both inversion and eversion ROM in the ankles of college athletic participants. Factors related to limb dominance and athletic participation may have influenced these findings. These results suggest that many of the assessment procedures utilized in the treatment of ankle ligamentous injuries may, in

fact, be inaccurate if their validity is dependent upon contralateral comparisons.

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Nelson AG et al.: Consequences of Combining Strength and Endurance Training Regimens. *Phys Ther* 70: 287-294, 1990.

This study was performed to determine if simultaneous training to increase torque production and cardiovascular endurance is counterproductive. Subjects consisted of 14 healthy, active men who had not participated in any regular training program for at least one year. Subjects were randomly assigned to three groups: an increased torque production (ITP) group ($n=5$), an endurance (END) group ($n=4$), and a combined increased torque production and endurance (COMBO) group ($n=5$). The ITP group underwent an isokinetic program consisting of three sets of six maximal repetitions of knee extensions and flexions at 30 degrees/second, four days per week. The END group exercised on a bicycle ergometer four days per week, progressing to an intensity of 85% maximal heart rate for 60 minutes. The COMBO group performed both programs four days per week. Training regimens for each group lasted 20 weeks. Subjects were tested for torque production, maximal oxygen consumption, muscle enzyme activity, and muscle fiber morphology before, during, and after the training program. The ITP and COMBO groups demonstrated significant gains in torque while the END group did not. During the first half of the study, both the END and COMBO groups experienced significant gains in maximal oxygen consumption. During the second half of the study, however, the END group experienced further significant gains while the COMBO group did not. Only the END group demonstrated a significant increase in citrate synthetase activity; no significant changes in myokinase activity occurred in any of the three groups. No significant change in fiber type distribution occurred in any group with the exception that the COMBO group demonstrated a decrease in the percentage of type IIa fibers with a similar increase in type I fibers. No hypertrophy occurred in any of the three groups. The authors concluded that simultaneous training for torque production and cardiovascular endurance may interfere with normal adaptations to endurance training, and that this interference is probably dependent on the characteristics of the individual training program.

Jennifer Donner
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Abadie BR: Physiological Responses to Grade Walking with Wrist and Hand-Held Weights. *Res Q Exer Sport* 61: 93-95, 1990.

In an effort to increase the metabolic cost of walking, individuals have begun walking while holding hand-held weights (HW). The belief that walking with HW (3-5 lbs)

will increase the energy cost of walking has been substantiated by several researchers. However, Graves et al. demonstrated that HW create an excessive elevation in heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) during walking exercise. The elevated blood pressure response during exercise with HW suggests that this form of physical activity may be contraindicated for individuals with artery disease or hypertension. This study was designed to determine whether walking with wrist weights (WW), which does not require an isometric contraction, would create significantly different physiological responses

when compared to the same work load with HW and walking with no additional weights (NW). This investigation indicates that both 6 lb. WW and HW exercises are effective in increasing the energy requirements of walking exercise. The increases in HR and SBP for both treatments appear to be within normal expected limits. The significant increase in DBP during the HW treatment was not a desirable outcome. This study indicates that wrist weight (WW) walking may be used to eliminate the undesirable DBP response observed during walking with HW.

Scott T. Doberstein
Millikin University
Decatur, IL

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Guide to Contributors

(Revised September 1990)

Athletic Training, JNATA, the professional journal of the National Athletic Trainers' Association (NATA), Inc., welcomes the submission of manuscripts which may be of interest to persons engaged in or concerned with the progress of the athletic training profession (athletic injury prevention, evaluation, management, and rehabilitation; administration of athletic training facilities and programs; and counseling and educating athletes concerning health care). Manuscripts should conform to the following:

SUBMISSION POLICIES

1. Submit one original and three copies of the entire manuscript (including photographs, artwork, and tables) to the editor.

2. We accept manuscripts for review with the understanding that they are original, have been submitted solely to *Athletic Training, JNATA*, and are not under simultaneous review by any other publication. All manuscripts must be accompanied by a letter signed by each author, and must contain the statements below. Manuscripts which are not accompanied by such a letter will not be reviewed.

"This manuscript contains original unpublished material that has been submitted solely to *Athletic Training, JNATA*, 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 *Athletic Training, JNATA*. In consideration of the NATA's taking action in reviewing and editing my (our) submission, the author(s) undesignated 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 *Athletic Training, JNATA* 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. *Athletic Training, JNATA* utilizes a double blind review process. Authors should take care that they are not identified in any way except on the title page.

5. Manuscripts are reviewed and edited to improve the effectiveness of communication between the author and the readers, and to assist the author in a presentation compatible with the accepted style of *Athletic Training, JNATA*. The author agrees to accept any minor corrections of the manuscript made by the editors.

6. Published manuscripts and accompanying artwork cannot be returned. Unused manuscripts will be returned when submitted with a stamped, self-addressed envelope.

STYLE POLICIES

7. See Day (Reference b in #19 below) for elaboration of the following points.

8. Personal pronouns (I, we), and the active voice are preferred. Use the third person for describing what happened, "it" or "we" (if more than one author) for describing what you did, and "you" or the imperative for instruction.

9. Each page must be typewritten on one side of 8 1/2 x 11 inch plain paper, double spaced, with a one and one-half inch left margin and one inch margins elsewhere. **Do not right justify pages.**

10. 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 (first numbered page)
- d. Text (body of manuscript)
- e. References
- f. Tables - each on a separate page
- g. Legends to illustrations
- h. Illustrations - each on a separate page

11. Begin numbering the pages of your manuscript with the abstract page as #1, and consecutively number all suc-

cessive pages.

12. 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.

13. The title page should also include the names, titles, and affiliations of each author, and the name, address, and phone number of the author to whom correspondence is to be directed.

14. 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.

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. It should 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 the subject at hand are often appropriate for the introduction, but a detailed review of the literature should be reserved for the discussion section. In this brief (1 to 2 paragraphs) review of the literature, identify and develop the magnitude and significance of the controversy. This is often done by pointing out differences between others' results, conclusions, and/or opinions. Remember, 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). Regardless of the type of article 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 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), resulting or 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 *Athletic Training, JNATA* receive, along with the submitted manuscript, a signed release form 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 other techniques.

e. A **Tip From the Field** is similar to a technique article but much shorter. The tip should be presented and its significance briefly discussed and related to other similar techniques.

17. The manuscript should not have a separate summary section - the abstract serves as a summary. It is appropriate, however, to tie the article together with a summary paragraph or list of conclusions at the end of the discussion section.

18. Citations in the text of the manuscript take the form of a number in parentheses, (7), 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 family names then initials, title of article, journal title with abbreviations as per *Index Medicus* (underlined), volume, inclusive pages, year; b) books: author(s), title of book (underlined), publisher, city and state of publication, year, inclusive pages of citation. Examples of references to a journal, book, chapter in an edited book, and presentation at a meeting are illustrated below.

a. Knight K: Tips for scientific/medical writers. *Athletic Training, JNATA* 25 (1): 47-50, 1990.

b. Day RA: *How to Write and Publish a Scientific Paper*. 3rd Ed. Phoenix: Oryx Press, 1988.

c. Albohm M: Common injuries in women's volleyball. In Scriber K, Burke EJ (eds): *Relevant Topics in Athletic Training*. Ithaca NY: Monument Publication, 1978, pp. 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. Las Vegas, Nev., June 15, 1978.

20. 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 which will be legible if reduced for publication. Tables must be typed, not handwritten. Photographs cannot be returned if the manuscript is published. Please refrain from using paper clips or writing on the back of photographs.

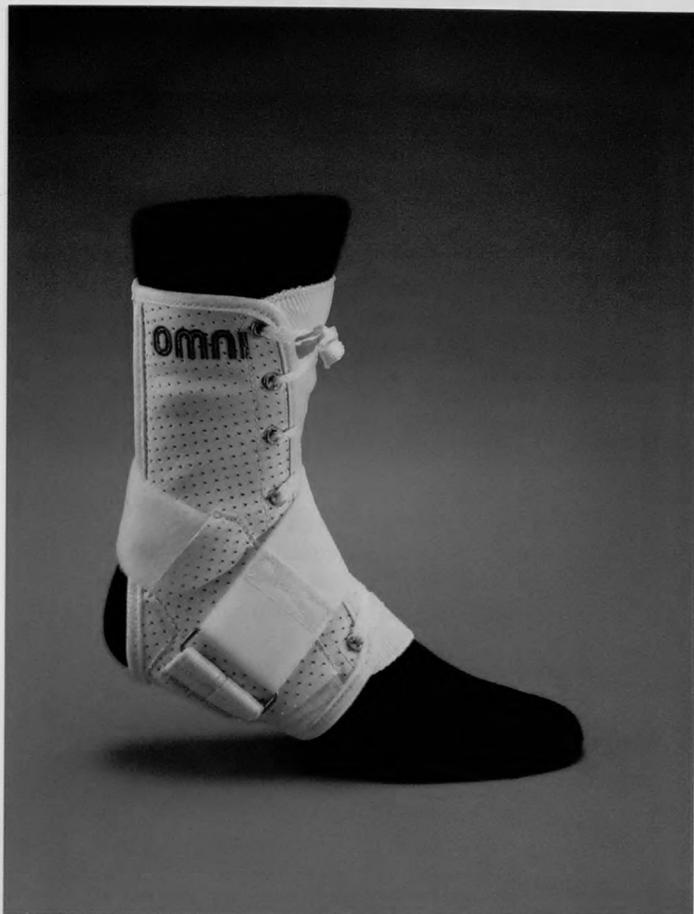
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Send manuscripts, **Case Studies**, and **Tips From the Field** to:

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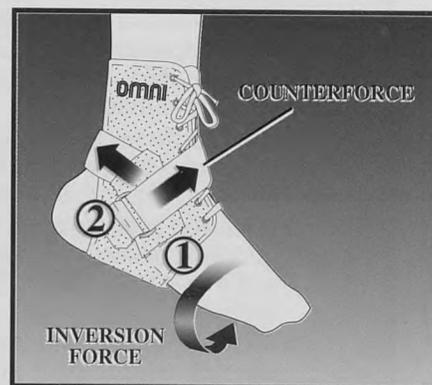
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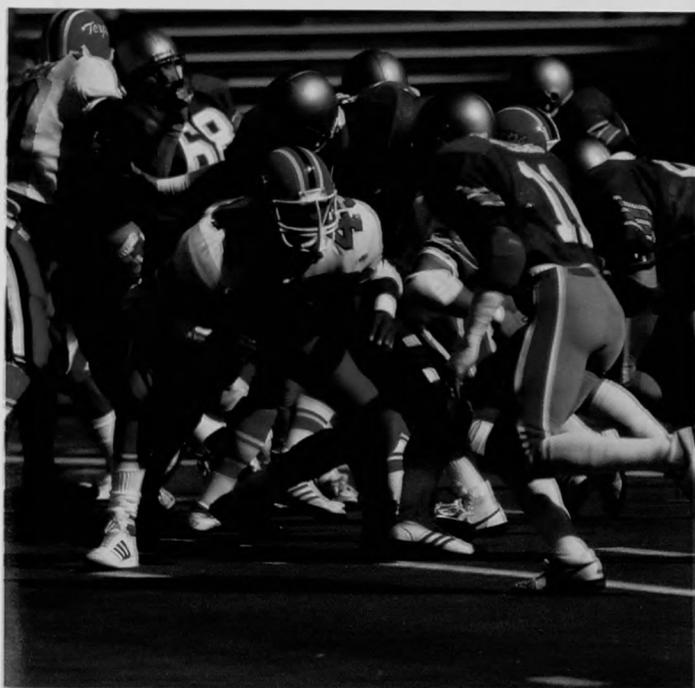
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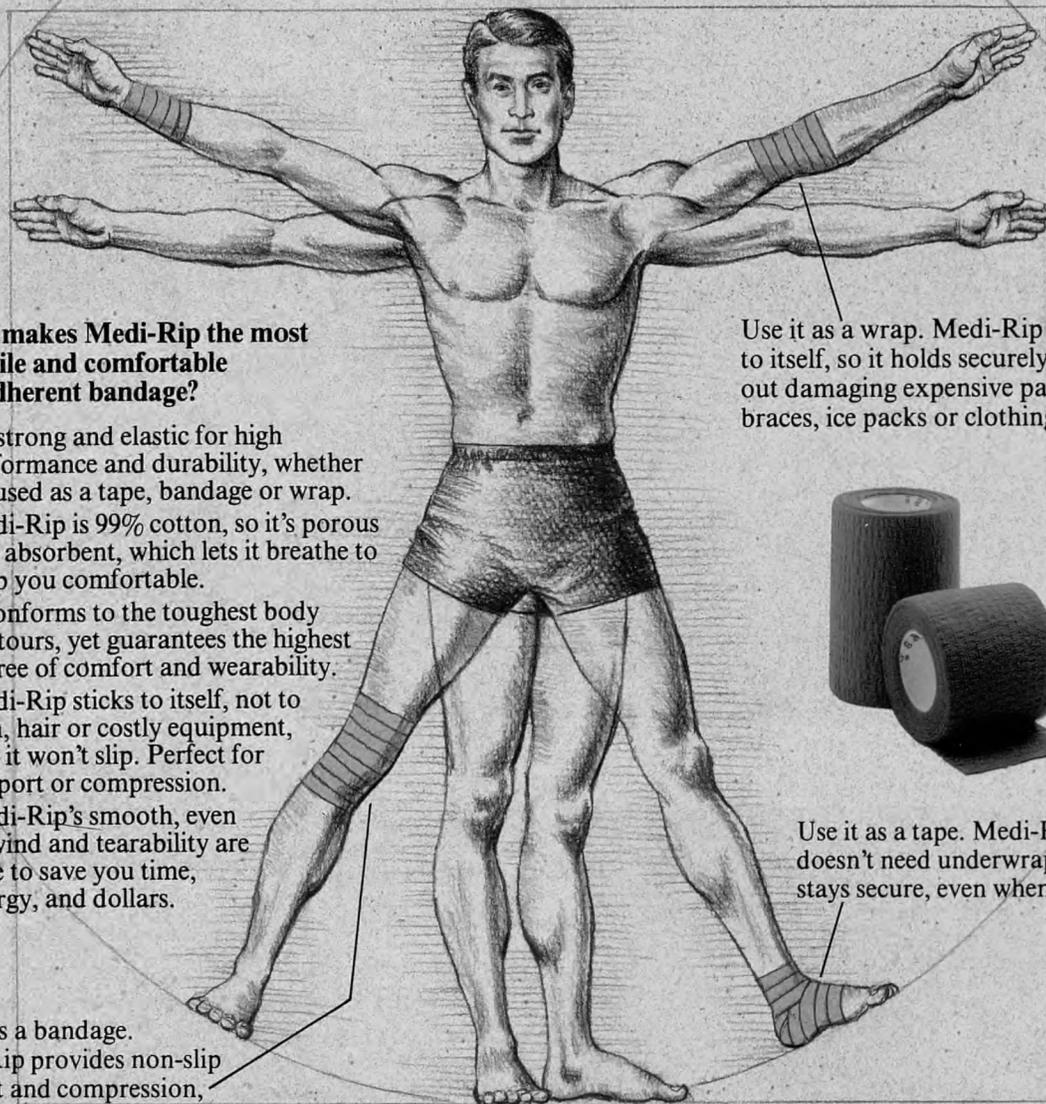
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Potpourri

Dennis Aten, MS, ATC, RPT

Professional Liability

*The American Academy of
Orthopaedic Surgeons Bulletin*

In December, 1989, the American Academy of Orthopaedic Surgeons (AAOS) issued a position statement regarding federal tort reform as it applies to professional liability.

The Academy is concerned about a number of serious failings of the court-based tort system in states that have not enacted federal tort reform. In these states:

- The court-based tort system is usually not prompt, with the average time from initiation of the suit to judgment or settlement being 5.5 years.
- The court-based tort system has inconsistent awards, with amounts that vary markedly in similar cases without obvious reasons. Some patients are compensated at excessive levels, while others receive nothing.
- The court-based tort system often causes unfair results. Physicians whose case management has been impeccable may be penalized by jury verdicts or forced settlements, based on the emotional appeal of a bad medical result.
- The court-based tort system fails to benefit the truly injured patient. Legal fees, insurance company overhead, and other costs of the system consume as much as 80 percent of the malpractice premium dollar, giving the injured patient a reduced share of the settlement.

At the federal level, the Academy specifically encourages a close examination of several tort reform options. These tort reform measures include, but are not limited to:

- A mandatory certificate of merit requiring that a medical liability claim be supported by an affidavit asserting that the claim has been reviewed and that it may have some merit.
- An opportunity for physicians to seek reimbursement for legal fees expended in the successful defense of a malpractice action.
- Basic requirements establishing federal criteria for the competence of expert witnesses.
- Controls or modifications to the contingency fee system, whereby attorneys receive a percentage of the amount awarded, because it contributes excessively to the overall cost of the system. Perhaps a sliding scale limitation on attorney contingent fees should be considered.
- Periodic payments of future damage awards in medical liability cases (usually lost wages and anticipated medical expenses).
- A specific cap on economic damages (pain and suffering).
- Mandatory offset of collateral sources of payment (usually

from health and/or disability benefits).

- A fault-based administrative law system for handling medical liability claims such as the proposal developed by the American Medical Association/Specialty Society Medical Liability Project.
- New approaches for arriving at just compensation of the truly injured patient to take issues of medical complexity out of the court-based tort system, e.g., ability to go to binding arbitration, or a system of designated compensable events.
- Limitation or prohibition of punitive damages.

Bad News?

Good Health Digest

Health professionals want to hear the bad news too! According to a recent article in the *New York Times*, doctors and medical researchers are troubled by the number of medical studies and research papers published in medical and scientific journals, which are not balanced by negative or contradictory articles. The *Times'* article claims that because negative results from studies are not published, medical personnel are denied information which might help them better treat their patients. The researchers charge that journals and some scientists are biased against publishing results that are inconclusive or that claim a certain medical theory does not hold water. The bottom line is: don't necessarily give 'em the bad news first, but give it to 'em.

Stress: It's Not all Bad

Good Health Digest

Some degree of stress is necessary for a healthy life. Consequently, people should not try to eliminate stress completely — which would be impossible anyway — but should strive to control the stressors which confront them, reports *The Effective Executive*.

"Some stresses are inherent in modern day living (pollution, inflation, noise, threats of nuclear war, rush-hour traffic), while others are the personal and unique reactions of an individual," writes Joanna Ross, PhD.

Stress can be controlled best by learning what your positive and negative stresses are. Ross suggests some areas to focus on in order to determine this:

- Muscle tension: Discover the times when you become tense. Do you detect certain patterns?
- Cognitive self-statements: Listen to your internal monologue. Is the voice harmful or helpful?

- Expectations: Are your standards for yourself realistic?
- Needs/Feelings: Do you relate to others what you feel?, or do you repress your feelings?
- Time Management: Are you in control of your time?, or is it in control of you? When are you most productive? Least productive?
- Long-term goals: What are your goals in life? Do you work toward achieving these every day?

Reflecting on these points and questions helps to put positive and negative stressors into perspective. And then, hopefully, stress can be sufficiently controlled and channelled.

Academy Offers Toll-Free Number as New Service

AAOS Reports

As part of its continuing mission to enhance communications with its fellowship, the Academy has a new, toll-free telephone number — (800) 346-2267. The number may be used at any time to call the Academy's Park Ridge offices.

"The new toll-free number is just one of the many new activities we hope to implement for the purpose of enhancing the quality of service we offer our members and orthopaedic surgery's other publics," Thomas C. Nelson, the Academy's executive director said.

If you find the number busy, you may still call (708) 823-7186. Also, many members of the staff have direct dial numbers which you may use to call them if you cannot get through on the toll-free line. The Academy has another toll-free number [(800) 626-6726] for its customer service operation. That number should be used to place orders for AAOS educational materials.

In other telephone news, please note the change in area code to 708. While Illinois Bell will allow a short grace period for those who continue to use the old area code (312), it is

recommended that anyone who calls the Academy should change his records and adopt the habit of using the new area code quickly. The new area code should be used to call the Orthopaedic Research and Education Foundation, American Orthopaedic Association, and all orthopaedic societies housed in the Academy building.

Are Left-Handers Injury Prone?

Good Health Digest

Left-handed people have it tough all around! For instance, they face twice the risk of serious accidents that right-handers do, according to a recent article in the *Fitness Bulletin*. A professor at the University of British Columbia conducted a study of 1,892 students and found that roads, work places, and homes are designed for right-handers. Additionally, statistics show that left-handers don't enjoy the longevity right-handers have. Surveys reveal that 13 percent of 20 year-olds are left-handers, but by the age of 50 only five percent of people are left-handers, and by age 80 very, very few left-handers remain.

AIDS

Running and Fitness

AIDS is not transmitted through saliva, sweat, tears, urine, respiratory droplets, handshaking, swimming pool water, communal bath water, toilets, food, or drinking water.

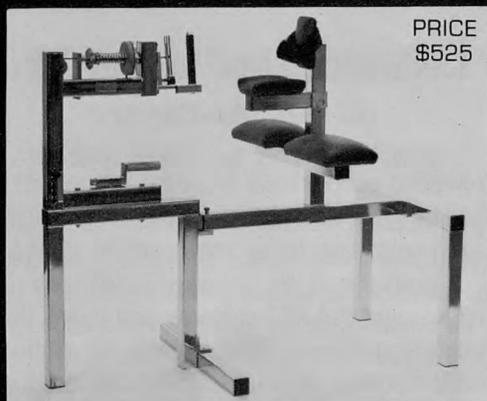
There is no evidence of a risk of transmission of AIDS when infected persons have no bleeding wounds or skin lesions.

(World Health Organization Consultation on AIDS and Sports, January 16, 1989, Geneva, Switzerland, quoted in *ACHPER Health & Fitness Newsletter*, Vol. 7, No. 1, p. 1)

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Book Review

Phil Callicut, EdD, ATC

Foot Orthoses: Principles and Clinical Applications

Kent K. Wu, MD
Williams & Wilkins
428 East Preston Street
Baltimore, MD 21202
393 pages, illustrated
Price: \$75.00

This book is written solely by Dr. Kent K. Wu, an orthopedist on the staff of Detroit's Henry Ford Hospital, and hands down is the best single volume on this subject I have examined. The text is lucid and thorough; the accompanying photographs, diagrams, and drawings are abundant and helpful, and the unusually comprehensive subject bibliographies that conclude each of the twelve chapters are extremely helpful.

On first viewing it would appear that only the final chapter, "Foot Orthoses, Sports Shoes, and Sports Medicine," directly pertains to athletic trainers or physical therapists who regularly treat athletes. And extremely valuable it is. Cov-

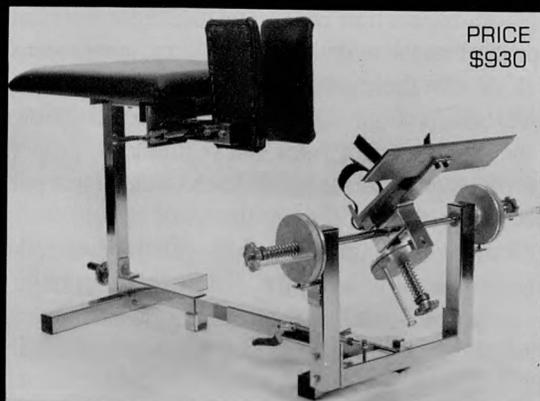
ered in varying degrees of detail are the anatomy of the sports shoe, general considerations of the diagnosis and treatment of running injuries, as well as specific and more detailed analyses of stress fractures of the foot, iliotibial band syndrome, compartment syndromes of the leg and foot, "shin splints," tendinous injuries of the leg and foot, and painful heel syndrome. The etiological and diagnostic descriptions of these injuries are particularly good, brief but comprehensive, regardless of any personal philosophy or prejudice one may have already developed, pro or con, as to the value of foot orthoses in their treatment.

But also useful are significant portions of eight more of the remaining eleven chapters, particularly the two that cover the examination and biomechanics of the foot, and the four that deal specifically with the fabrication and application of foot orthoses to specific injuries and conditions.

These things said, I would like to round out by noting that the value of foot orthoses in the treatment or maintenance of athletic injuries is, like certain other treatment modalities — ankle stabilizers vs. taping, for instance — hotly debated by some athletic trainers, roundly contested by others. Would that foot orthoses were indeed the panacea for the myriad of

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lower extremity conditions they have been touted by some health professionals to relieve or cure. However, how many times have you found that \$8.00 over-the-counter "arch supports," or posted heel lifts at even half that price, have worked and have done the job adequately, where professionally neutral cast rigid orthoses at \$350 had failed and had been cast aside by the athlete as uncomfortable and ineffective? Where does the fault lie? Who is to blame?

Too often the blame lies with the athlete himself, commonly a long distance runner who believed or had been convinced that symptomatic relief would be immediate the moment he slipped the orthoses in his Nikes. "Why," he asks, "waste time with rest, ice, compression, elevation?" "Let's get on with it," he says.

Occasionally, however, the blame rests with a practicing health professional who has prescribed and made casts for the orthoses. Within the last year, for example, one professional journal has cautioned against the too frequent dispensing of foot orthoses, stating directly and clearly that simpler, less expensive means of approach would have been equally effective and beneficial.

Thus it has been, and continues to remain, up to the team physician and athletic trainer to determine, based on experience and empirical results, whether and when to employ foot orthoses in the treatment of the athletes in their care, and what kind of orthoses — rigid, semi-rigid, flexible, neutral, or

posted — to use. In fact, I am encouraged by the fact that many athletic trainers and physical therapists have begun to fabricate their own foot orthoses in-house and frequently have achieved gratifying results. Skill comes with practice, experience, and discrimination in the choice of subject and condition.

Dr. Wu's *Foot Orthoses: Principles and Clinical Applications* is highly recommended to you without reservation, either for your personal or school library. This book will add to or clarify your knowledge of a variety of lower extremity injuries, including diagnosis and their treatment with foot orthoses. It is not completely self-serving, for you will also learn of the limitations of foot orthoses as well as of the various benefits. So, pre-existing prejudices notwithstanding, read this book; use it. Let practice be your guide. In-house fabrication of foot orthoses is relatively inexpensive and time efficient. Even if you send off your neutral casts or lightweight moulds, you can learn from Dr. Wu's book many of the options open to you with regard to the types of foot orthoses available, and their application based on his own wide experience and expertise. *Foot Orthoses: Principles and Clinical Applications* serves admirably as introduction or practical guide.

Stuart Wright, DSCh, FSSCh, MBChA
Winston-Salem, NC

Video Review

Tom Gocke, MS, ATC

"He Coulda Been Great"

Virginia Orthopedic Information Systems, Inc.

8919 Three Chopt Road

Richmond, VA 23229

Color 1/2" VHS

Informational book provided

Playing Time: 45 minutes (approximate)

Price: \$54.95

Over the past months I have had the opportunity to review several videotape presentations that deal with the prevention, treatment, and rehabilitation of athletic injuries. Many of these tapes have provided an overview approach to dealing with athletic injuries. However, I have not come across many videotapes that concentrate their efforts on just one aspect of injury care. That is, until I reviewed **"He Coulda Been Great."**

This program confines its area of focus to only those issues associated with preventing knee injuries. While it may, at first, come across as a narrow view of athletic injuries, this avenue addresses one of the most important issues in dealing with the knee — prevention.

"He Coulda Been Great" outlines its approach to preventing knee injuries in three sections. In the first section, the authors address the importance of strength, flexibility, and agility drills in preventing knee injury. In addition to providing the viewer with sound guidelines in preventing injury, they also outline practices that are considered to put the athlete at an increased risk of injury. The authors take this opportunity to explain why these practices are risky. The viewer is also given a rationale for engaging in a year-round conditioning program for the knee. Here, the important issue is that it takes longer than a few weeks to get the musculature of the knee into sufficient condition to prevent injury.

The second section is devoted to identification of those risks factors that can be controlled in reducing injuries to the knee. The authors discuss how congenital malalignments can potentially predispose the athlete to knee injury, what means can be used to identify these problems, and what can be done to minimize the effects of malalignment. The remaining time is spent on the importance of rules and regulations, proper maintenance of playing surfaces, and selection of proper playing shoes in preventing injury to the knee.

The last section of this videotape deals with the acute, on-the-field management of knee injury. While this portion of the tape does not go into great length on evaluation techniques or pathology, it does outline important concerns to remember when dealing with knee injuries.

Overall, I was impressed with the information that was presented in **"He Coulda Been Great."** It provides the viewer with specific measures for increasing strength, flexibility, and agility in order to help prevent knee injuries. While the videotape depicted only football scenarios, the information presented can be applied to all sports that have the potential to produce knee injuries. I especially liked the amount of time spent on the prevention of knee injuries. While treatment and rehabilitation of injuries is important, of equal importance is the prevention of injuries. I applaud the authors for this approach. Many videotape presentations cover the evaluation, treatment, and rehabilitation of knee injuries; however, few spend much time on the prevention aspect of injury care.

"He Coulda Been Great" would be a good teaching tool for the athletic trainer. The information booklet and tape are easy to follow and make for interesting viewing. I found the booklet to be informative and free of discrepancies when compared to information presented in the tape. This is an excellent program and I would recommend it to anyone who is interested in learning more about preventing knee injuries and strengthening the knee.

Current Literature

Brian Barry, MA, ATC

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11 (3): 108, 1976
15 (4): 236, 1980
17 (3): 216, 1982
18 (4): 286, 1983
18 (4): 295, 1983
20 (2): 114, 1985
23 (3): 286, 1988
25 (4): 335, 1990
- Duck walk, knee injury**
6 (4): 166, 1971

E

Ear, cauliflower
3 (2): 14, 1968
17 (2): 114, 1982

Eating disorders
23 (1): 47, 1988
23 (2): 137, 1988

Education
1b (3): 9, 1957
1d (3): 14, 1959
1k (2): 7, 1966
15 (1): 47, 1980
17 (4): 288, 1982
22 (2): 111, 1987
23 (1): 41, 1988
23 (2): 131, 1988
24 (4): 330, 1989

Education, coaches
12 (4): 212, 1977

Education, graduate
9 (4): 166, 1974

Education programs
5 (2): 10, 1970
6 (2): 68, 1971
8 (1): 12, 1973
16 (2): 125, 1981
25 (2): 123, 1990

Education trends
25 (2): 118, 1990

Effusion
18 (1): 23, 1983

Elbow, anatomy
14 (3): 131, 1979

Elbow, biomechanics
14 (3): 131, 1979

Elbow injury
11 (2): 68, 1976
15 (2): 78, 1980

Elbow rehabilitation
23 (1): 11, 1988

Elbow, "tennis"
10 (3): 171, 1975
23 (4): 316, 1988

Electrical stimulation
16 (1): 59, 1981
17 (4): 262, 1982
19 (4): 278, 1984
20 (4): 291, 1985
24 (3): 238, 1989

Electrolyte drinks
21 (1): 20, 1986

Electrolytes
5 (4): 7, 1970

Electromyograph (EMG)
18 (2): 106, 1983

EMG, rotator cuff
25 (1): 40, 1990

Emergencies
1j (4): 3, 1965

Emergency airway
14 (1): 38, 1979
16 (1): 48, 1981

Emergency care
5 (3): 20, 1970
7 (2): 45, 1972

Emergency equipment
1g (4): 12, 1962

Emergency extrication
14 (2): 74, 1979

Emergency information
22 (2): 127, 1987

Emergency protocol
23 (1): 59, 1988
23 (2): 147, 1988

Employment, athletic trainers
9 (1): 36, 1974
14 (1): 32, 1979

Epiphyseal plate
19 (1): 61, 1984

Equipment, emergency
1g (4): 12, 1962

Equipment, hydration
11 (4): 164, 1976

Ergogenic aids
2 (3): 6, 1967
5 (2): 12, 1970
9 (2): 68, 1974
11 (3): 108, 1976

Ethics
25 (4): 340, 1990

Evaluation
15 (3): 174, 1980

Evaluation, foot
1g (4): 3, 1962

Evaluation, injury
24 (1): 36, 1989

Evaluation, knee
10 (3): 160, 1975

14 (4): 225, 1979

17 (2): 135, 1982

22 (1): 29, 1987

Evaluation, low back

25 (3): 228, 1990

Exercise

1f (4): 13, 1961

1g (4): 2, 1962

Exercise, flexibility

18 (1): 37, 1983

Exercise, football

1h (2): 2, 1963

Exercise, heart

1f (2): 14, 1961

Exercise, hip

1d (1): 15, 1959

Exercise, isometric

1g (3): 6, 1962

1h (4): 12, 1963

1i (3): 15, 1964

1k (1): 7, 1966

Exercise physiology

19 (3): 185, 1984

23 (4): 364, 1988

Exercise prescription

17 (4): 283, 1982

Exercise, progressive resistive (PRE)

1b (1): 12, 1957

Exercise, therapeutic

12 (1): 42, 1977

13 (3): 123, 1978

Eye

14 (3): 156, 1979

16 (4): 254, 1981

Eye, contacts

1d (2): 4, 1959

Eye injuries

20 (3): 195, 1985

20 (4): 288, 1985

20 (4): 311, 1985

22 (3): 207, 1987

Eye protection

10 (1): 43, 1975

F**Face, fracture**

17 (2): 102, 1982

Faceguards

3 (1): 20, 1968

Facial injuries

16 (2): 113, 1981

17 (2): 102, 1982

Fatalities, high school

1g (3): 12, 1962

Fatigue, surgery

1h (3): 7, 1963

Faults shoulder stretch

16 (3): 182, 1981

Feet

14 (3): 144, 1979

Female, hemoglobin

25 (2): 120, 1990

Females, athletics

13 (3): 131, 1978

Females, isokinetics

25 (2): 114, 1990

Females, strength

23 (4): 325, 1988

Fencing

18 (4): 317, 1983

Fibula fracture, taping

19 (2): 121, 1984

Field hockey, injuries

11 (3): 104, 1976

21 (2): 220, 1986

Field tips

16 (1): 48, 1981

Finger fracture

25 (1): 55, 1990

Finger splinting

16 (2): 98, 1981

17 (3): 215, 1982

Fitness norms

20 (3): 210, 1985

Flexibility

6 (2): 62, 1971

16 (1): 23, 1981

18 (1): 37, 1983

Flexibility, hamstring

25 (2): 128, 1990

Flexibility, hip

18 (1): 56, 1983

Flexibility, norms

20 (3): 210, 1985

Flexibility, proprioceptive

neuromuscular facilitation (PNF)

4 (2): 14, 1969

Flexibility, shoulder

16 (3): 187, 1981

Fluid replacement

23 (3): 215, 1988

Fluids

17 (4): 275, 1982

Foot

1d (1): 1, 1959

1g (3): 10, 1962

Foot anatomy

16 (1): 43, 1981

Foot biomechanics

10 (2): 96, 1975

16 (1): 43, 1981

Foot, cold applications

25 (2): 122, 1990

Foot evaluation

1g (4): 3, 1962

Foot injury

1e (4): 10, 1960

1h (3): 15, 1963

16 (3): 173, 1981

17 (2): 93, 1982

17 (4): 268, 1982

20 (2): 142, 1985

Foot, orthotics

20 (2): 120, 1985

Foot, pad

1h (3): 19, 1963

Foot, pronated

16 (1): 53, 1981

Foot rehabilitation

15 (4): 231, 1980

18 (1): 64, 1983

Foot taping

1c (2): 12, 1958

Football

1d (3): 12, 1959

1e (4): 15, 1960

1g (3): 12, 1962

19 (1): 55, 1984

20 (1): 35, 1985

Football, body composition

5 (3): 8, 1970

Football, conditioning

1d (2): 14, 1959

10 (2): 78, 1975

Football equipment

3 (1): 20, 1968

4 (3): 9, 1969

5 (2): 15, 1970

Football, exercises

1h (2): 2, 1963

Football, head injury

2 (2): 14, 1967

Football, heat

3 (3): 6, 1968

Football injury

1e (2): 4, 1960

1g (4): 10, 1962

1i (1): 15, 1964

7 (3): 77, 1972

12 (1): 28, 1977

12 (1): 34, 1977

13 (3): 146, 1978

15 (2): 98, 1980

17 (4): 279, 1982

18 (4): 323, 1983

21 (2): 124, 1986

21 (2): 207, 1986

21 (2): 248, 1986

22 (1): 19, 1987

22 (1): 54, 1987

23 (2): 185, 1988

24 (2): 133, 1989

Football, injury patterns

20 (2): 104, 1985

Football, injury research

19 (3): 189, 1984

20 (3): 213, 1985

Football, injury survey

7 (4): 109, 1972

Football, knee injuries

25 (2): 127, 1990

25 (3): 233, 1990

Football, neck collar

17 (3): 175, 1982

Football, neck injury

4 (3): 13, 1969

25 (2): 147, 1990

Football rules

1i (2): 5, 1964

Football rules, injury

7 (6): 215, 1972

Football, shoes

6 (3): 115, 1971

13 (1): 22, 1978

Football shoes, injury

5 (2): 19, 1970

Football shoes, swivel

8 (2): 54, 1973

Football, strength

1k (1): 1966

Footwear

10 (2): 104, 1975

Fracture, ankle

23 (2): 110, 1988

Fracture, electromuscular stimulation

(EMS)

16 (1): 59, 1981

Fracture, hand

3 (1): 8, 1968

Fracture, mandible

16 (2): 113, 1981

Fracture, stress

12 (3): 126, 1977

20 (1): 16, 1985

G**Gait**

16 (1): 53, 1981

Gait analysis

22 (1): 6, 1987

Gibney ankle taping

2 (3): 16, 1967

Glenohumeral dislocation

25 (4): 369, 1990

Goniometry

14 (3): 161, 1979

Gore-Tex ligament

23 (3): 253, 1988

Graduate programs

9 (4): 166, 1974

Grieving

24 (1): 39, 1989

Groin, dermatology

7 (4): 112, 1972

Groin, injury

17 (1): 43, 1982

Gymnastic injuries

25 (2): 118, 1990

Gymnastics, taping

14 (4): 212, 1979

H**Hallux sesmoids**

20 (2): 142, 1985

Hamstring, flexibility

25 (2): 128, 1990

Hamstring injuries

17 (1): 43, 1982

22 (3): 216, 1987

Hamstring strain

7 (2): 36, 1972

22 (3): 223, 1987

Hamstring strength

25 (2): 128, 1990

Hand, cold applications

25 (2): 122, 1990

Hand injury

1i (1): 13, 1964

3 (1): 8, 1968

15 (1): 34, 1980

Hand padding

20 (4): 329, 1985

Hand rehabilitation

6 (2): 56, 1971

23 (4): 3

- 1k (3): 13, 1966
5 (4): 7, 1970
9 (2): 78, 1974
19 (3): 166, 1984
20 (2): 96, 1985
- Heat modalities**
1c (1): 3, 1958
- Heat vs. cryotherapy**
9 (4): 177, 1974
- Heating modalities**
18 (2): 136, 1983
- Heatstroke**
25 (2): 192, 1990
- Heel cup**
8 (4): 183, 1973
1c (3): 4, 1958
- Helmets**
6 (4): 157, 1971
- Helmets, concussions**
24 (2): 133, 1989
- Hematocrit, female**
25 (2): 120, 1990
- Hematology**
25 (1): 76, 1990
- Hemoglobin, female**
25 (2): 120, 1990
- Hiccups**
17 (3): 165, 1982
- High school injuries**
25 (4): 344, 1990
- High schools, athletic training**
4 (2): 10, 1969
11 (4): 180, 1976
15 (2): 85, 1980
16 (3): 180, 1981
20 (3): 199, 1985
20 (4): 312, 1985
21 (2): 116, 1986
21 (3): 215, 1986
- High schools, fatalities**
1g (3): 12, 1962
- Hip, cryotherapy**
19 (3): 183, 1984
- Hip dislocation**
10 (3): 159, 1975
21 (2): 124, 1986
- Hip, flexibility**
1d (1): 15, 1959
18 (1): 56, 1983
- Hip fracture**
21 (2): 124, 1986
- Hip injury**
18 (4): 304, 1983
- Hip pointer, peddling**
21 (2): 128, 1986
- Hip rehabilitation**
16 (3): 182, 1981
- Hip stretching**
25 (2): 114, 1990
- History**
1a (1): 1, 1956
- History, athletic training**
1g (1): 16, 1962
19 (4): 256, 1984
23 (1): 27, 1988
- History, National Athletic Trainers' Association**
15 (3): 173, 1980
15 (4): 261, 1980
16 (1): 28, 1981
- History, physical fitness**
1g (1): 10, 1962
1i (2): 12, 1964
- HIV**
See Human Immunodeficiency Virus
- Hockey injuries**
17 (2): 88, 1982
- Human Immunodeficiency Virus (HIV)**
24 (1): 27, 1989
- Humidity, turf**
7 (2): 47, 1972
- Hydration**
21 (1): 20, 1986
- Hydration, equipment**
11 (4): 164, 1976
- Hydration, performance**
19 (4): 260, 1984
- Hydrocolloid dressings**
23 (4): 341, 1988
- Hydrostatic weighing**
21 (4): 328, 1986
- Hydrotherapy**
5 (3): 14, 1970
13 (4): 215, 1978
22 (2): 115, 1987
22 (3): 219, 1987
22 (4): 326, 1987
- Hydrotherapy, heart**
9 (3): 131, 1974
- Hyperoxic gas, trauma**
23 (3): 238, 1988
- Hyperventilation**
1c (1): 9, 1958
- Hypnosis**
1d (4): 6, 1959
- Hypothermia**
18 (4): 330, 1983
- I**
- Ice hockey**
7 (6): 179, 1972
16 (4): 238, 1981
- Ice hockey, acromioclavicular (AC) joint**
18 (2): 103, 1983
- Ice hockey injuries**
5 (3): 16, 1970
- Ice hockey mask**
8 (1): 19, 1973
- Ice hockey, stress**
7 (6): 185, 1972
- Ice massage**
1i (1): 12, 1964
- Iliotibial band**
21 (1): 32, 1986
- Iliotibial band friction syndrome**
25 (4): 356, 1990
- Immobilization, arm**
16 (1): 21, 1981
- Inflammation, management**
20 (4): 298, 1985
- Ingrown nails**
19 (4): 306, 1984
- Injections**
1k (3): 7, 1966
- Injuries, cervical**
25 (2): 147, 1990
- Injury**
1g (4): 10, 1962
1i (2): 10, 1964
- Injury, alienation**
25 (3): 269, 1990
- Injury, decisions**
1g (2): 15, 1962
- Injury, disabled**
25 (2): 123, 1990
- Injury evaluation**
15 (3): 174, 1980
24 (1): 36, 1989
- Injury, follow-up**
1c (2): 4, 1958
- Injury, football rules**
7 (6): 215, 1972
- Injury, football shoes**
8 (2): 54, 1973
- Injury, healing**
1f (1): 3, 1961
- Injury, high schools**
25 (4): 344, 1990
- Injury, liability**
1c (3): 1, 1958
- Injury management**
1b (2): 1, 1957
5 (3): 20, 1970
7 (2): 45, 1972
- Injury management, neck**
4 (2): 8, 1969
- Injury prevention**
1d (1): 7, 1959
1e (1): 4, 1960
13 (3): 148, 1978
- Injury prone athletes**
10 (1): 26, 1975
- Injury record keeping**
9 (4): 184, 1974
- Injury registry**
25 (2): 125, 1990
- Injury research, football**
19 (3): 189, 1984
20 (3): 213, 1985
- Injury survey**
13 (1): 14, 1978
15 (4): 246, 1980
17 (4): 279, 1982
- Injury survey, college**
7 (4): 109, 1972
- Injury survey, football**
7 (4): 109, 1972
- Injury statistics**
22 (1): 19, 1987
- Injury, trauma**
1f (1): 3, 1961
- Injury, wrestling**
13 (4): 186, 1978
- Insurance, athletic**
8 (1): 6, 1973
- Insurance, liability**
6 (2): 55, 1971
- Intracranial injury**
25 (2): 129, 1990
- Iontophoresis**
6 (2): 66, 1971
- Isokinetic strength**
25 (2): 114, 1990
- Isokinetic testing**
23 (4): 325, 1988
- Isokinetic torque**
23 (1): 16, 1988
24 (2): 129, 1989
25 (2): 125, 1990
- Isokinetics**
6 (1): 18, 1971
6 (3): 110, 1971
14 (2): 83, 1979
16 (2): 138, 1981
17 (4): 257, 1982
18 (2): 110, 1983
19 (1): 16, 1984
19 (1): 26, 1984
21 (4): 319, 1986
23 (3): 250, 1988
25 (3): 240, 1990
- Isokinetics, knee**
14 (4): 205, 1979
14 (4): 225, 1979
- Isokinetics, shoulder**
22 (2): 124, 1987
23 (4): 333, 1988
- Isometrics**
1g (3): 6, 1962
1i (3): 15, 1964
1k (1): 7, 1966
- Isometrics, basketball**
1h (4): 12, 1963
- Isometrics, football**
1h (2): 2, 1963
- Isometrics, knee**
1i (2): 2, 1964
- Isotonics, knee**
23 (1): 16, 1988
- J**
- Jock itch**
8 (3): 106, 1973
- Joint load, anterior cruciate ligament (ACL)**
25 (2): 119, 1990
- Joint mobilization**
19 (4): 267, 1984
- Jones fracture**
17 (4): 268, 1982
- Jones fracture, splint**
23 (3): 247, 1988
- Journal**
1a (1): 1, 1956
13 (4): 196, 1978
- Journal, history**
21 (2): 262, 1986
- Journal manuscripts**
11 (3): 127, 1976
- K**
- Kin-Com**
21 (2): 235, 1986
- Kinesiology, exercise**
1g (4): 2, 1962
- Knee anatomy**
1g (1): 13, 1962
13 (3): 113, 1978
- Knee, anterior cruciate ligament (ACL)**
16 (4): 244, 1981
- Knee, ACL surgery**
23 (3): 253, 1988
- Knee, ACL taping**
16 (3): 214, 1981
- Knee, arthroscopy**
18 (2): 100, 1983
- Knee, biomechanics**
13 (3): 113, 1978
- Knee evaluation**
10 (3): 160, 1975
17 (2): 79, 1982
22 (1): 29, 1987
- Knee injury**
1c (3): 12, 1958
1d (3): 5, 1959
1e (1): 10, 1960
1f (1): 14, 1961
1g (3): 8, 1962
1h (2): 12, 1963
1k (3): 3, 1966
- 4 (4): 10, 1969
6 (4): 166, 1971
7 (3): 77, 1972
10 (3): 141, 1975
11 (3): 104, 1976
13 (2): 78, 1978
13 (4): 179, 1978
14 (1): 15, 1979
17 (2): 104, 1982
17 (2): 108, 1982
17 (3): 207, 1982
20 (2): 104, 1985
- Knee instability**
23 (3): 226, 1988
- Knee, isokinetics**
14 (4): 205, 1979
14 (4): 225, 1979
- Knee, joint mobilization**
23 (2): 123, 1988
- Knee, lateral aspect**
18 (1): 41, 1983
- Knee, medial collateral ligament (MCL) injury**
17 (4): 249, 1982
- Knee, meniscal injury**
24 (4): 349, 1989
- Knee, Osgood-Schlatter's disease**
7 (2): 43, 1972
- Knee, posterior cruciate ligament (PCL) injury**
21 (2): 248, 1986
- Knee, rehabilitation**
1b (1): 12, 1957
1d (1): 4, 1959
1g (3): 6, 1962
1i (2): 2, 1964
6 (1): 17, 1971
10 (1): 34, 1975
14 (3): 151, 1979
14 (4): 232, 1979
15 (3): 171, 1980
23 (3): 230, 1988
- Knee reinjury**
1c (1): 1, 1958
- Knee, rotary instability**
10 (3): 160, 1975
17 (2): 79, 1982
- Knee, skeletal asymmetry**
8 (2): 68, 1973
13 (2): 78, 1978
- Knee surgery**
1i (4): 3, 1964
- Knee taping**
1c (2): 3, 1958
13 (4): 206, 1978
16 (2): 108, 1981
16 (4): 248, 1981
17 (2): 135, 1982
21 (4): 337, 1986
24 (3): 247, 1989
- Knee, "triad" injury**
10 (4): 217, 1975
- Knee braces, lateral**
21 (2): 112, 1986
25 (2): 160, 1990
- Knee function**
25 (2): 123, 1990
- Knee injuries, football**
25 (2): 127, 1990
25 (3): 233, 1990
- Knee injury, prevention**
4 (2): 12, 1969
- Knee injury, shoes**
5 (2): 19, 1970
- Knee tests, Lachman**
25 (4): 330, 1990
- Knees, joint load**
25 (2): 119, 1990
- L**
- Lachman test**
25 (4): 330, 1990
- Lacrosse equipment**
12 (1): 22, 1977
- Lateral knee braces**
21 (2): 112, 1986
- Law suits**
20 (2): 133, 1985
25 (2): 212, 1990
25 (3): 219, 1990
- Leg injury**
20 (1): 16, 1985
- Legality**
1c (3): 1, 1958
1e (1): 1, 1960
1f (4): 15, 1961
20 (1): 10, 1985
20 (2): 117, 1985

- 20 (2): 133, 1985
20 (3): 256, 1985
24 (1): 46, 1989
- Legality, modalities**
10 (4): 208, 1975
- Liability**
1e (1): 1, 1960
19 (1): 41, 1984
20 (1): 10, 1985
20 (3): 256, 1985
- Liability, injury**
1c (3): 1, 1958
- Liability insurance**
6 (2): 55, 1971
- Liability, physician**
1h (4): 15, 1963
- Low back**
1b (3): 3, 1957
1e (4): 6, 1960
8 (1): 16, 1973
21 (1): 15, 1986
- Low back anatomy**
11 (3): 114, 1976
- Low back, anomalies**
1g (2): 2, 1962
- Low back, biomechanics**
11 (3): 114, 1976
- Low back, disc disease**
12 (1): 13, 1977
- Low back injury**
11 (4): 169, 1976
- Low back, management**
25 (3): 228, 1990
- Low back pain**
2 (4): 12, 1967
11 (3): 114, 1976
23 (3): 243, 1988
- Low back rehabilitation**
12 (2): 65, 1977
- Lower extremity injury**
7 (2): 45, 1972
22 (1): 6, 1987
- Lower leg rehabilitation**
19 (1): 55, 1984
- Lung**
19 (2): 129, 1984
- Lymphatic system, edema**
18 (4): 339, 1983
- M**
- Malpractice**
19 (1): 41, 1984
20 (2): 117, 1985
- Managers**
1d (3): 12, 1959
- Manual therapy, knee**
23 (2): 123, 1988
- Marathoners**
18 (4): 292, 1983
- Marfan's syndrome**
21 (4): 341, 1986
- Marijuana**
18 (4): 295, 1983
- Maxillofacial trauma**
25 (2): 132, 1990
- Medical care**
1g (2): 12, 1962
- Medical care, schools**
15 (2): 85, 1980
- Medication**
16 (1): 56, 1981
16 (3): 202, 1981
17 (2): 100, 1982
18 (4): 286, 1983
- Menarche**
19 (4): 303, 1984
- Meniscus injuries**
25 (2): 116, 1990
- Meniscectomy**
1c (1): 1, 1958
10 (1): 34, 1975
- Meniscectomy, medial**
11 (3): 104, 1976
- Meralgia paresthetica**
18 (4): 304, 1983
- Metatarsal pad**
1h (3): 19, 1963
- Michigan trainers**
23 (1): 32, 1988
- Mobilization, knee**
23 (2): 123, 1988
- Modalities**
1c (1): 3, 1958
1d (4): 8, 1959
8 (2): 60, 1973
10 (3): 138, 1975
14 (2): 97, 1979
16 (1): 59, 1981
17 (4): 262, 1982
20 (1): 65, 1985
- Modalities, atrophy**
24 (3): 238, 1989
- Modalities, edema**
19 (4): 278, 1984
- Modalities, heat**
15 (2): 109, 1980
17 (1): 15, 1982
18 (2): 136, 1983
20 (4): 291, 1985
- Modalities, legality**
10 (4): 208, 1975
- Modalities, swelling**
18 (1): 23, 1983
- Modality safety**
13 (4): 215, 1978
17 (2): 123, 1982
- Modalities, transcutaneous electrical nerve stimulation (TENS)**
13 (3): 146, 1978
14 (2): 97, 1979
23 (3): 235, 1988
- Modalities, ultrasound**
8 (2): 60, 1973
10 (3): 138, 1975
- Moles**
7 (5): 145, 1972
- Mouth injury**
24 (3): 236, 1989
- Mouth protection**
23 (4): 357, 1988
- Mouthguards**
1g (1): 4, 1962
1j (1): 3, 1965
5 (2): 15, 1970
10 (1): 38, 1975
16 (2): 100, 1981
16 (2): 111, 1981
25 (3): 244, 1990
- Muscle injury**
8 (4): 166, 1973
- Muscle pain, analgesics**
20 (1): 29, 1985
- Muscle ratio**
18 (2): 110, 1983
- Muscle soreness**
10 (1): 42, 1975
15 (4): 260, 1980
25 (2): 122, 1990
- Muscle soreness, delayed**
25 (2): 116, 1990
- Muscle spasms**
20 (2): 121, 1985
- Muscle strains**
5 (4): 11, 1970
- Myositis ossificans**
22 (3): 193, 1987
- Myotonic muscle distress**
8 (4): 166, 1973
- Myths**
9 (4): 180, 1974
- N**
- Nasal septal injuries**
21 (1): 10, 1986
- National Athletic Injury Reporting System (NAIRS)**
15 (2): 98, 1980
15 (4): 246, 1980
17 (4): 279, 1982
- National Athletic Trainers' Association (NATA)**
6 (1): 8, 1971
1d (4): 4, 1959
1k (2): 3, 1966
- NATA, certification**
4 (1): 10, 1969
13 (2): 86, 1978
17 (4): 264, 1982
21 (2): 120, 1986
24 (3): 234, 1989
- NATA, convention**
5 (2): 6, 1970
9 (2): 83, 1974
- NATA, graduate programs**
9 (4): 166, 1974
- NATA, history**
15 (3): 173, 1980
15 (4): 261, 1980
16 (1): 28, 1981
- NATA, public relations**
22 (4): 358, 1987
- National Football League (NFL)**
15 (4): 221, 1980
22 (3): 202, 1987
- Navicular fracture**
17 (3): 189, 1982
- Neck**
1b (1): 1, 1957
- Neck injury management**
12 (2): 88, 1977
24 (2): 108, 1989
- Neck collar**
4 (3): 9, 1969
- Neck collar, football**
17 (3): 175, 1982
- Neck, rehabilitation**
1h (1): 2, 1963
- Neck roll**
18 (1): 66, 1983
- Nerve palsy**
18 (1): 76, 1983
- Newell, "Pinky"**
19 (4): 250, 1984
- NFL**
See National Football League
- Nose, fracture**
16 (3): 170, 1981
- Nutrition**
1c (2): 7, 1958
1c (2): 16, 1958
1d (1): 3, 1959
1e (2): 16, 1960
1k (4): 3, 1966
4 (2): 8, 1969
4 (4): 6, 1969
9 (2): 68, 1974
18 (2): 137, 1983
23 (2): 141, 1988
- Nutrition, marathoners**
18 (4): 292, 1983
- Nutrition, wrestling**
1k (4): 6, 1966
- O**
- Ocular injuries**
20 (3): 195, 1985
20 (4): 311, 1985
20 (4): 288, 1985
- Olympics**
1b (2): 10, 1957
14 (3): 165, 1979
- Oncology**
25 (1): 76, 1990
- Ophthalmoscope/otoscope**
25 (2): 119, 1990
- Oral injuries**
24 (3): 236, 1989
- Organization**
11 (2): 60, 1976
13 (4): 211, 1978
13 (4): 212, 1978
14 (3): 165, 1979
15 (3): 148, 1980
16 (1): 68, 1981
16 (2): 120, 1981
17 (3): 191, 1982
17 (4): 309, 1982
18 (1): 49, 1983
20 (4): 302, 1985
21 (1): 22, 1986
23 (4): 354, 1988
- Organization, kit**
14 (1): 10, 1979
- Orthotic plastics**
18 (1): 77, 1983
- Orthotics**
20 (2): 120, 1985
25 (2): 113, 1990
- Orthotics, pronation**
25 (2): 126, 1990
- Orthotron**
23 (3): 250, 1988
- Orthotron, hip**
16 (3): 182, 1981
- Orthotron, shoulder**
22 (2): 124, 1987
- Osgood-Schlatter's disease**
7 (2): 43, 1972
16 (4): 267, 1981
- Osteoarthritis**
16 (4): 250, 1981
- Otoscope, use**
25 (2): 119, 1990
- Overuse injury**
25 (2): 126, 1990
- Oxygen**
23 (3): 238, 1988
- P**
- PBATS**
See Professional Baseball Athletic Trainers
- Posterior cruciate ligament (PCL) injury**
21 (2): 248, 1986
- Proprioceptive neuromuscular facilitation (PNF)**
4 (2): 14, 1969
10 (1): 44, 1975
21 (1): 26, 1986
- Progressive resistive exercise (PRE)**
1b (1): 12, 1957
1c (3): 14, 1958
- Pad, metatarsal**
1h (3): 19, 1963
- Padding**
1i (3): 12, 1964
14 (2): 68, 1979
16 (2): 117, 1981
- Padding, acromioclavicular (AC) joint**
15 (2): 102, 1980
- Padding, customized**
11 (3): 137, 1976
- Padding, hip pointer**
21 (2): 128, 1986
- Padding, injury**
9 (1): 21, 1974
- Pads, injury**
1b (2): 7, 1957
- Pagers, athletic trainers**
23 (2): 147, 1988
- Pain**
15 (1): 42, 1980
22 (2): 100, 1987
- Pain, cold-induced**
25 (2): 126, 1990
- Pain, referred**
15 (1): 20, 1980
- Pain, transcutaneous electrical nerve stimulation (TENS)**
23 (3): 235, 1988
- Painful heel syndrome**
21 (2): 128, 1986
- Pan American games**
2 (4): 14, 1967
- Patella**
10 (3): 132, 1975
17 (4): 249, 1982
- Patellar tendon**
13 (4): 179, 1978
- Patellofemoral syndrome**
21 (2): 235, 1986
25 (2): 107, 1990
- Peace Corps**
1i (2): 16, 1964
- Performance**
1c (2): 7, 1958
- Performance, fluids**
17 (4): 275, 1982
- Performance, profiles**
17 (3): 181, 1982
- Performance, warm-up**
1c (1): 8, 1958
- Peroneal nerve palsy**
25 (3): 247, 1990
- Peroneal nerve syndrome**
1e (1): 10, 1960
- Peroneal tendon injury**
23 (1): 45, 1988
- Peroneal tendon, taping**
23 (1): 45, 1988
- Phencyclidine**
15 (1): 30, 1980
- Philosophy of athletic training**
1a (1): 3, 1956
- Phonophoresis**
15 (2): 109, 1980
- Physical education**
1i (2): 16, 1964
- Physical examinations**
1g (2): 12, 1962
1j (2): 3, 1965
1j (2): 4, 1965
1j (3): 24, 1965
5 (1): 9, 1970
21 (2): 122, 1986
- Physical fitness**
1g (1): 10, 1962
- Physical fitness, history**
1i (2): 12, 1964
- Physical therapists**
23 (2): 153, 1988
- Physician**
1b (3): 11, 1957
8 (3): 118, 1973
- Physician liability**
1h (4): 15, 1963
- Physicians, team**
1h (3): 12, 1963
1h (2): 7, 1963
22 (3): 211, 1987

- Physiology**
23 (4): 364, 1988
- Piriformis syndrome**
23 (3): 243, 1988
- Plantar fasciitis, taping**
22 (4): 317, 1987
- Plantar warts**
5 (4): 8, 1970
- Plastic bags, disposable**
7 (1): 14, 1972
- Pneumothorax**
19 (2): 129, 1984
- Podiatric examinations**
25 (4): 311, 1990
- Podiatry**
17 (2): 93, 1982
- Pool therapy**
22 (4): 326, 1987
- Power**
14 (2): 83, 1979
14 (3): 158, 1979
- Pre-game**
1j (4): 12, 1965
- Pre-game, emotions**
1f (2): 10, 1961
- Pre-game meal, liquid**
1h (4): 2, 1963
- Pre-season**
1f (4): 6, 1961
1f (4): 7, 1961
- Prevention, ankle injury**
4 (2): 6, 1969
- Prevention, blisters**
2 (4): 9, 1967
- Prevention, hypothermia**
18 (4): 330, 1983
- Prevention, injury**
1e (1): 4, 1960
1h (3): 15, 1963
13 (3): 148, 1978
14 (3): 149, 1979
- Prevention, isometrics**
1i (3): 15, 1964
- Prevention, knee injury**
4 (2): 12, 1969
- Prevention, shin splints**
2 (1): 9, 1967
10 (4): 204, 1975
- Prevention, soreness**
10 (1): 42, 1975
- Prevention, taping**
14 (1): 34, 1979
- Preventive equipment**
13 (4): 206, 1978
- Prickly heat**
7 (3): 76, 1972
- Proctology**
1f (4): 9, 1961
- Professional Baseball Athletic Trainers (PBATS)**
23 (2): 156, 1988
- Professionalism**
22 (4): 329, 1987
- Program directors**
16 (2): 125, 1981
- Pronation**
16 (1): 53, 1981
22 (1): 6, 1987
- Pronation, orthotics**
25 (2): 126, 1990
- Proprioception, ankle**
25 (2): 119, 1990
- Proprioception devices**
25 (3): 261, 1990
- Protective equipment**
15 (4): 228, 1980
20 (1): 33, 1985
- Protective equipment, acromioclavicular (AC) joint**
9 (1): 21, 1974
15 (2): 102, 1980
- Protective equipment, ankle**
17 (2): 121, 1982
17 (3): 201, 1982
- Protective equipment, chin**
16 (2): 113, 1981
- Protective equipment, elbow**
10 (3): 171, 1975
13 (1): 12, 1978
14 (2): 68, 1979
- Protective equipment, eye**
10 (1): 43, 1975
- Protective equipment, face**
3 (1): 20, 1968
5 (3): 16, 1970
8 (1): 19, 1973
- Protective equipment, female**
18 (4): 317, 1983
- Protective equipment, finger**
16 (2): 98, 1981
- Protective, equipment, foot**
14 (3): 144, 1979
16 (2): 117, 1981
- Protective equipment, hand**
12 (3): 122, 1977
14 (2): 68, 1979
14 (3): 146, 1979
15 (1): 34, 1980
20 (4): 329, 1985
- Protective equipment, head**
1g (3): 13, 1962
6 (4): 160, 1971
- Protective equipment, heel**
1c (3): 4, 1958
8 (4): 183, 1973
- Protective equipment, hip**
16 (4): 238, 1981
21 (2): 128, 1986
- Protective equipment, mouth**
1d (2): 13, 1959
1g (1): 4, 1962
1j (1): 3, 1965
5 (2): 15, 1970
10 (1): 38, 1975
16 (2): 100, 1981
16 (2): 111, 1981
- Protective equipment, neck**
4 (3): 9, 1969
17 (3): 175, 1982
- Protective equipment, ribs**
1b (2): 7, 1957
- Protective equipment, shin**
5 (2): 112, 1980
16 (1): 26, 1981
- Protective equipment, shoulder**
12 (1): 22, 1977
16 (1): 21, 1981
16 (4): 238, 1981
- Protective equipment, spine**
15 (2): 82, 1980
- Protective equipment, thigh**
1b (2): 7, 1957
1i (3): 12, 1964
- Protective padding, hand**
20 (4): 329, 1985
- Protein supplements**
9 (2): 68, 1974
- Psychology**
1d (4): 6, 1959
1f (2): 10, 1961
1h (1): 12, 1963
1h (2): 14, 1963
1i (4): 13, 1964
9 (4): 180, 1974
12 (2): 58, 1977
15 (1): 42, 1980
15 (3): 144, 1980
17 (3): 167, 1982
18 (1): 34, 1983
19 (3): 171, 1984
20 (4): 294, 1985
21 (2): 104, 1986
21 (4): 312, 1986
22 (2): 100, 1987
23 (2): 152, 1988
24 (1): 39, 1989
24 (2): 159, 1989
- Publicity**
20 (3): 193, 1985
- Publicity, athletic training**
13 (4): 200, 1978
- Q**
- Quadriceps, rehabilitation**
16 (2): 122, 1981
- Quinine sulfate**
20 (2): 121, 1985
- R**
- RTV-11 casts**
25 (2): 123, 1990
- Racial issues**
5 (3): 13, 1970
- Radial fracture**
22 (3): 221, 1987
- Radios, two way**
3 (1): 6, 1968
- Reconditioning**
1d (1): 11, 1959
- Record keeping**
16 (1): 68, 1981
17 (3): 191, 1982
- Record keeping, computer**
25 (4): 321, 1990
- Record keeping system**
9 (4): 184, 1974
- Rectal conditions**
1f (4): 9, 1961
- Reflex Sympathetic Dystrophy**
22 (2): 120, 1987
- Rehabilitation**
1d (4): 8, 1958
1k (2): 11, 1966
12 (1): 42, 1977
13 (3): 123, 1978
15 (3): 174, 1980
17 (4): 283, 1982
18 (1): 23, 1983
- Rehabilitation, ankle**
1i (1): 8, 1964
1k (3): 14, 1966
4 (4): 14, 1969
13 (4): 178, 1978
15 (4): 231, 1980
17 (1): 15, 1982
19 (4): 278, 1984
- Rehabilitation, anterior cruciate ligament (ACL)**
21 (2): 200, 1986
25 (2): 113, 1990
25 (2): 118, 1990
25 (2): 122, 1990
- Rehabilitation, behavioral**
24 (3): 217, 1989
- Rehabilitation, biofeedback**
24 (2): 159, 1989
- Rehabilitation, cryotherapy**
8 (3): 106, 1973
9 (4): 178, 1974
- Rehabilitation, elbow**
23 (1): 11, 1988
- Rehabilitation, equipment**
13 (4): 178, 1978
17 (1): 60, 1982
- Rehabilitation, foot**
15 (4): 231, 1980
18 (1): 56, 1983
- Rehabilitation, football**
1e (2): 4, 1960
- Rehabilitation, free weights**
20 (3): 206, 1985
- Rehabilitation, hand**
6 (2): 56, 1971
23 (4): 361, 1988
- Rehabilitation, hip**
16 (3): 182, 1981
- Rehabilitation, hydrotherapy**
22 (3): 219, 1987
- Rehabilitation, isokinetics**
6 (1): 18, 1971
6 (3): 110, 1971
16 (2): 138, 1981
- Rehabilitation, joint mobilization**
19 (4): 267, 1984
- Rehabilitation, knee**
1b (1): 12, 1957
1d (1): 4, 1959
1d (1): 11, 1959
1g (3): 8, 1962
1i (2): 2, 1964
6 (1): 17, 1971
10 (1): 34, 1975
13 (1): 32, 1978
14 (3): 151, 1979
14 (4): 232, 1979
15 (3): 171, 1980
23 (3): 226, 1988
24 (4): 349, 1989
- Rehabilitation, low back**
1e (4): 6, 1960
12 (2): 65, 1977
- Rehabilitation, lower leg**
19 (1): 55, 1984
21 (2): 151, 1986
- Rehabilitation, muscle**
8 (4): 166, 1973
9 (4): 177, 1974
- Rehabilitation, neck**
1h (1): 2, 1963
- Rehabilitation, patella**
21 (2): 235, 1986
- Rehabilitation, pool**
5 (3): 14, 1970
22 (4): 326, 1987
- Rehabilitation, progressive resistive exercise (PRE)**
1c (3): 14, 1958
1e (1): 12, 1960
- Rehabilitation, proprioceptive neuromuscular facilitation (PNF)**
21 (1): 26, 1986
- Rehabilitation, quadriceps**
16 (2): 122, 1981
- Rehabilitation, shin**
2 (1): 8, 1967
2 (1): 9, 1967
19 (4): 271, 1984
- Rehabilitation, shoulder**
1b (4): 1, 1957
1c (2): 1, 1958
1f (1): 10, 1961
1h (2): 16, 1963
13 (1): 34, 1978
14 (1): 22, 1979
14 (4): 218, 1979
19 (3): 214, 1984
22 (2): 124, 1987
23 (4): 348, 1988
- Rehabilitation, strains**
1h (4): 9, 1963
2 (4): 6, 1967
5 (4): 11, 1970
- Rehabilitation, surgery**
1h (3): 7, 1963
- Rehabilitation, wrist**
23 (4): 361, 1988
- Rehydration**
1k (3): 13, 1966
- Relationship**
1h (3): 6, 1963
- Research**
7 (5): 139, 1972
23 (3): 212, 1988
23 (3): 223, 1988
24 (4): 333, 1989
- Respiratory emergencies**
3 (4): 12, 1968
- Respiratory injury**
3 (4): 12, 1968
- Responsibilities**
1i (3): 17, 1964
- Return to play**
1h (1): 14, 1963
5 (2): 7, 1970
- Rib injury**
1h (2): 4, 1963
- Rib protectors**
17 (3): 224, 1982
- Ringworm**
8 (3): 106, 1973
- Rotator cuff exercises**
25 (1): 40, 1990
- Rotator cuff strength**
25 (2): 127, 1990
- Rules, football**
1i (2): 5, 1964
- Runners, overuse injury**
10 (3): 132, 1975
- S**
- Sacro iliac (SI) dysfunction**
21 (1): 15, 1986
- Safety, athletic training**
1d (4): 14, 1959
- Safety, athletics**
13 (3): 131, 1978
- Safety, modalities**
13 (4): 215, 1978
- Sanitation, athletics**
1d (4): 13, 1959
- Scapula fracture**
20 (1): 35, 1985
- Schools, athletics**
1b (1): 1, 1957
- Sciatic nerve entrapment**
25 (4): 351, 1990
- Secondary schools, athletic trainers**
3 (4): 6, 1968
23 (4): 313, 1988
23 (4): 322, 1988
- Seizures**
18 (1): 29, 1983
- Sever's Disease**
21 (2): 131, 1986
- Sexually Transmitted Disease (STD)**
18 (2): 126, 1983
24 (1): 17, 1989
- Shin protector**
16 (1): 26, 1981
- Shin splints**
2 (1): 8, 1967
2 (1): 9, 1967
24 (1): 27, 1989
- Shin splints, prevention**
1c (1): 11, 1958
1i (2): 8, 1964
10 (4): 204, 1975
19 (4): 271, 1984
- Shin splints, taping**
1h (4): 6, 1963
22 (3): 216, 1987
25 (1): 53, 1990

- Shock**
1f (4): 13, 1961
- Shoe, swivel**
8 (2): 54, 1973
- Shoes, athletic**
10 (2): 104, 1975
- Shoes, cleated**
6 (3): 115, 1971
- Shoes, football**
13 (1): 22, 1978
- Shoes, knee injury**
5 (2): 15, 1970
- Shoulder**
12 (2): 94, 1977
- Shoulder, anatomy**
12 (3): 141, 1977
- Shoulder, biomechanics**
12 (3): 141, 1977
- Shoulder, dislocation**
1b (2): 3, 1957
25 (4): 369, 1990
- Shoulder impingement syndrome**
23 (4): 348, 1988
- Shoulder, injury**
11 (2): 68, 1976
20 (1): 35, 1985
- Shoulder, isokinetics**
23 (4): 333, 1988
- Shoulder, mechanics**
1f (2): 3, 1961
- Shoulder musculature**
25 (2): 120, 1990
- Shoulder, rehabilitation**
1b (4): 1, 1957
1c (2): 1, 1958
1f (1): 10, 1961
1h (2): 16, 1963
13 (1): 34, 1978
14 (1): 22, 1979
14 (4): 218, 1979
19 (3): 214, 1984
22 (2): 124, 1987
23 (4): 348, 1988
- Shoulder, rotator cuff**
19 (3): 214, 1984
- Shoulder, stretch**
1e (1): 3, 1960
16 (3): 187, 1981
- Shoulder, throwing injury**
12 (4): 202, 1977
- Shoulder pads**
21 (2): 228, 1986
- Shoulder protection**
21 (2): 228, 1986
- Sickle cell trait**
10 (1): 19, 1975
- Skeletal asymmetry**
17 (3): 207, 1982
- Skeletal asymmetry, knee**
8 (2): 68, 1973
- Skiing**
15 (2): 112, 1980
- Skin**
7 (1): 8, 1972
- Skin reactions**
7 (2): 33, 1972
- Skin disorders**
7 (3): 76, 1972
- Skin disorders, groin**
7 (4): 112, 1972
- Skin infections**
24 (1): 12, 1989
- Skinfold caliper**
22 (1): 23, 1987
- Sling, arm**
16 (1): 21, 1981
- Smokeless tobacco**
25 (1): 10, 1990
- Soccer**
16 (1): 66, 1981
21 (2): 227, 1986
- Soccer injuries**
12 (1): 28, 1977
- Special Olympics, athletic trainers**
20 (3): 204, 1985
- Spinal cord injury**
1g (2): 16, 1962
- Spinal injury**
9 (3): 122, 1974
- Spine board**
1g (4): 12, 1962
- Spleen**
13 (4): 190, 1978
- Splint, Jones fracture**
23 (3): 247, 1988
- Splinting**
1f (1): 6, 1961
- Splinting, finger**
16 (2): 98, 1981
- 17 (3): 215, 1982
- Splinting, hand**
1i (1): 13, 1964
- Spondylolisthesis**
12 (1): 13, 1977
- Spondylolysis**
12 (1): 13, 1977
- Sports medicine**
1k (4): 14, 1966
- Sports medicine centers**
23 (1): 22, 1988
- Stenosis, cervical spine**
25 (2): 138, 1990
- Steroids**
9 (4): 186, 1974
20 (2): 114, 1985
- Strains**
1h (4): 9, 1963
2 (4): 6, 1967
5 (4): 11, 1970
- Strength**
1b (1): 8, 1957
6 (2): 62, 1971
10 (4): 189, 1975
14 (2): 83, 1979
14 (3): 158, 1979
16 (1): 66, 1981
- Strength, dehydration**
25 (2): 116, 1990
- Strength, development**
11 (2): 75, 1976
21 (4): 315, 1986
- Strength, females**
23 (4): 325, 1988
- Strength, hamstring**
25 (2): 128, 1990
- Strength, rotator cuff**
25 (2): 127, 1990
- Strength training**
12 (3): 146, 1977
- Stress**
1h (2): 14, 1963
- Stress, athletic trainer**
19 (2): 115, 1984
- Stress, ice hockey**
7 (6): 185, 1972
- Stress, injury**
25 (1): 23, 1990
- Stress fractures**
12 (3): 126, 1977
20 (1): 16, 1985
- Stress fractures, leg**
24 (1): 31, 1989
- Stretching**
15 (1): 42, 1980
- Stretching, hip**
18 (1): 56, 1983
25 (2): 114, 1990
- Stretching, proprioceptive neuromuscular facilitation (PNF)**
4 (2): 14, 1969
- Stretching, shoulder**
1e (1): 3, 1960
- Student athletic trainers**
1d (3): 14, 1959
12 (4): 214, 1977
24 (2): 144, 1989
- Subluxation, knee**
17 (2): 104, 1982
- Substance abuse**
25 (4): 335, 1990
- Subtalar instability, taping**
25 (2): 127, 1990
- Subungual hematoma**
22 (4): 378, 1987
- Supplements**
4 (2): 8, 1969
11 (3): 124, 1976
- Supplements, protein**
9 (2): 68, 1974
- Surfing injuries**
19 (2): 105, 1984
- Surgery, anterior cruciate ligament (ACL)**
21 (2): 200, 1986
23 (3): 253, 1988
- Surgery, fatigue**
1h (3): 7, 1963
- Surgery, knee**
1i (4): 3, 1964
1k (3): 3, 1966
- Surgery, meniscectomy**
14 (3): 151, 1979
- Surgery, meniscus**
24 (4): 349, 1989
- Survey**
1a (1): 6, 1956
- Swelling**
1f (1): 12, 1961
- Swimming**
11 (3): 124, 1976
- Swimming, casts**
12 (3): 122, 1977
- T**
- Transcutaneous electrical nerve stimulation (TENS)**
13 (3): 146, 1978
14 (2): 97, 1979
23 (3): 235, 1988
- Tape quality**
10 (4): 214, 1975
- Taping**
1d (2): 11, 1959
18 (1): 52, 1983
- Taping, ankle**
1c (2): 12, 1958
1g (3): 16, 1962
1i (4): 6, 1964
2 (3): 16, 1967
4 (2): 6, 1969
4 (4): 10, 1969
7 (1): 10, 1972
7 (3): 73, 1972
7 (5): 146, 1972
7 (5): 150, 1972
9 (2): 94, 1974
9 (3): 128, 1974
13 (3): 152, 1978
14 (1): 34, 1979
14 (3): 149, 1979
14 (4): 227, 1979
15 (2): 94, 1980
17 (2): 121, 1982
17 (3): 218, 1982
18 (1): 72, 1983
18 (2): 121, 1983
19 (3): 178, 1984
22 (4): 321, 1987
24 (4): 339, 1989
- Taping, arch**
17 (1): 30, 1982
- Taping, fibula**
19 (2): 121, 1984
- Taping, gymnastics**
14 (4): 212, 1979
- Taping, hand**
21 (2): 227, 1986
- Taping, knee**
1c (2): 3, 1958
13 (4): 206, 1978
16 (2): 108, 1981
16 (3): 214, 1981
16 (4): 248, 1981
17 (2): 135, 1982
21 (4): 337, 1986
24 (3): 247, 1989
- Taping, plantar fasciitis**
22 (4): 317, 1987
- Taping, pronation**
25 (2): 126, 1990
- Taping, shin splints**
1h (4): 6, 1963
22 (3): 216, 1987
- Taping, subtalar instability**
25 (2): 127, 1990
- Taping table, tips**
14 (4): 224, 1979
15 (1): 50, 1980
23 (4): 354, 1988
- Team physician**
1g (2): 14, 1962
1h (3): 12, 1963
- Teeth**
1d (2): 13, 1959
7 (1): 12, 1972
10 (1): 38, 1975
16 (2): 111, 1981
20 (1): 74, 1985
- Teeth, avulsion**
24 (2): 139, 1989
- Tennis elbow**
10 (3): 171, 1975
23 (4): 316, 1988
- Thermography**
9 (1): 30, 1974
- Thigh contusion pad**
25 (2): 163, 1990
- Thigh injuries**
22 (3): 217, 1987
- Thoracic injury**
1e (2): 11, 1960
22 (4): 291, 1987
23 (2): 148, 1988
- Thoracic outlet**
21 (4): 302, 1986
- Throwing injuries**
12 (4): 202, 1977
- Tibial displacement**
25 (2): 114, 1990
- Tibial fracture**
16 (4): 269, 1981
- Tibiofibular joint**
17 (2): 104, 1982
- Tobacco, contusions**
15 (4): 238, 1980
- Tobacco, smokeless**
17 (3): 216, 1982
22 (2): 146, 1987
25 (3): 264, 1990
- Tobacco use**
9 (3): 137, 1974
- Toe caps, cryotherapy**
15 (1): 33, 1980
- Torque, isokinetic**
25 (2): 125, 1990
- Tourette's Syndrome**
25 (3): 254, 1990
- Track**
1k (1): 2, 1966
- Track injuries**
17 (1): 57, 1982
- Track and field injuries**
11 (4): 186, 1976
- Traction**
21 (2): 151, 1986
- Training, baseball**
1f (1): 7, 1961
- Training room**
13 (3): 120, 1978
14 (4): 224, 1979
16 (2): 120, 1981
19 (1): 19, 1984
- Training room, safety**
16 (4): 263, 1981
- Training room, tips**
7 (1): 14, 1972
15 (1): 50, 1980
- Training room facilities**
21 (1): 22, 1986
- Trauma**
1f (1): 3, 1961
- Trauma, hyperoxic gas**
23 (3): 238, 1988
- Trauma, shock**
1f (4): 13, 1961
- Tumor**
24 (4): 342, 1989
- Turf burns**
23 (4): 341, 1988
- Turf toe, orthosis**
22 (3): 215, 1987
- U**
- Ulnar nerve**
23 (1): 11, 1988
- Ultrasound**
5 (4): 8, 1970
8 (2): 60, 1973
10 (3): 138, 1975
20 (1): 65, 1985
- V**
- Vascular injury**
22 (4): 291, 1987
- Vasodilation**
8 (3): 106, 1973
- Vastus medialis obliquus (VMO), rehabilitation**
10 (1): 34, 1975
15 (4): 248, 1980
- Visceral injury**
15 (1): 20, 1980
- Vision**
14 (3): 156, 1979
- Vitamin B₁₂**
1k (4): 3, 1966
- Vitamins**
1g (1): 10, 1962
- W**
- Warm-up**
1c (1): 8, 1958
- Weather, cold**
18 (4): 330, 1983
- Weight gain**
22 (4): 319, 1987
- Weight loss**
3 (2): 10, 1968
20 (3): 283, 1985
23 (1): 47, 1988

Weight loss, wrestling
3 (2): 8, 1968

Weight training
1b (1): 8, 1957
1d (3): 1, 1959
1k (1): 2, 1966
1k (1): 10, 1966
10 (3): 128, 1975
18 (1): 68, 1983
21 (4): 315, 1986

Weights, free
20 (3): 206, 1985

Weights, homemade
17 (1): 60, 1982

Women, athletic training
8 (2): 82, 1973
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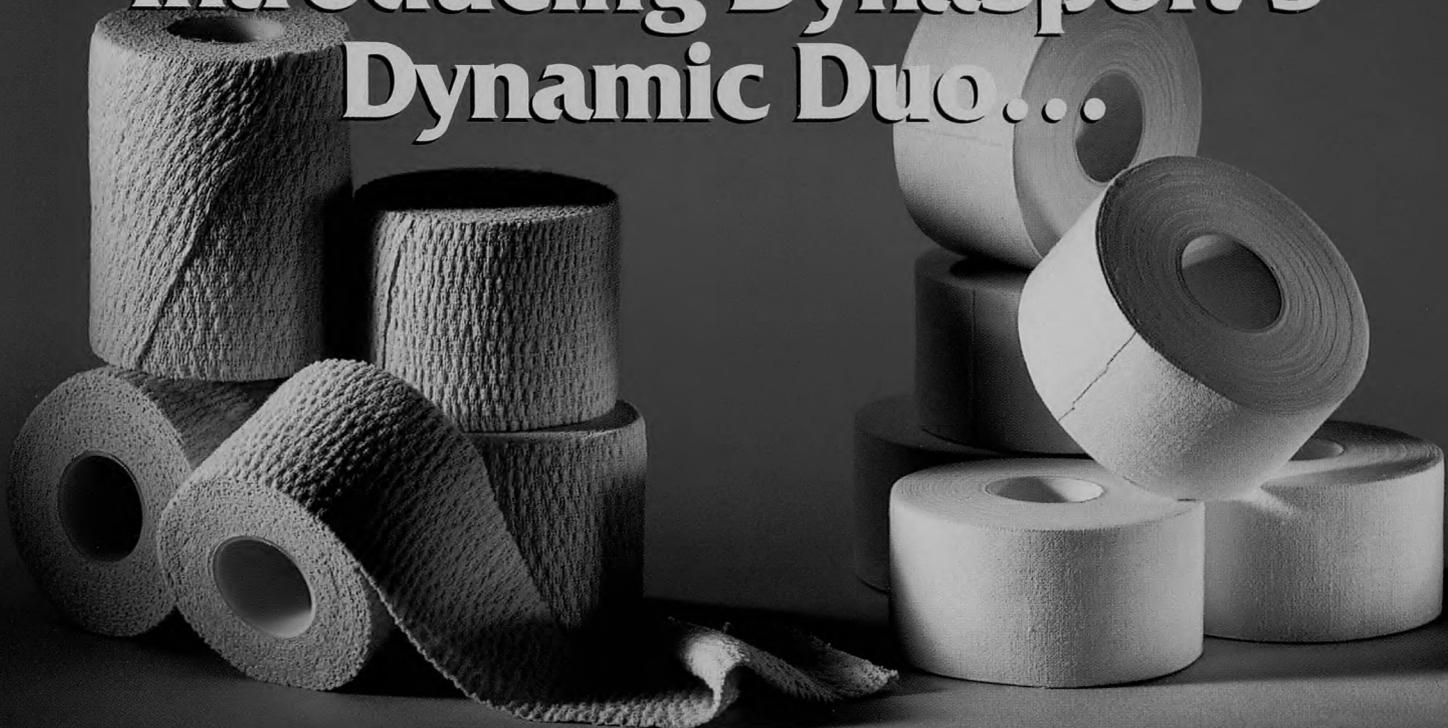
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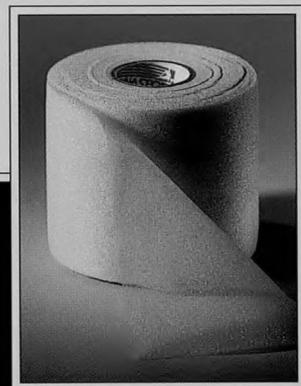
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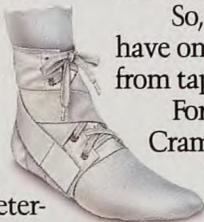
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