The Ankle Report

The amount of research on ankle injuries is expansive—but maybe too expansive for a busy athletic trainer to read. That's why we've compiled it into one comprehensive article.

By Dr. Rod Walters

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For over 100 years, medical professionals have been conducting research on the prevention and treatment of ankle injuries. Way back in 1895, V.P. Gibney published an article in the New York Medical Journal titled, "Sprained Ankle: a treatment that involves no loss of time, requires no crutches, and is not attended with an ultimate impairment of function." Gibney was talking about taping ankles in his article—by wrapping the ankle with strips of rubber plaster.

Although Gibney devised this technique for treating ankle injuries, we now know it as an option for prevention. We also know that ankle braces have a role in warding off the ever-prevalent ankle injury. But what is the best way to prevent an initial or recurring ankle sprain?

There is not one simple answer. But there is a plethora of research on the topic that gives some direction. For this article, I have analyzed research on ankle injuries from over 80 published manuscripts and textbooks and put it together into one comprehensive piece. From "The effect of ankle wrapping on motor performance," published in 1972 in Athletic Training, to "First-time inversion ankle ligament trauma: the effects of sex, level of competition, and sport on the incidence of injury," published in the American Journal of Sports Medicine last year, when pieced together, the many studies reveal some interesting advice.

BACKGROUND

Some of the research reveals no surprises. For example, the foot and ankle are among the most commonly injured body parts of recreational and competitive sports participants. An estimated 25,000 ankle sprains occur daily in the United States. Though recovery from the initial injury is likely, re-injury often results in moderation or discontinuation of sports activity.

The ankle joint comprises the tibia, fibula, and talus, and results in the motions of plantar flexion and dorsiflexion. The stability of the joint arises from the bony articulations combined with ligaments and muscles working together. The motions of inversion and eversion occur distal to the ankle joint at the subtalar articulation. The fibula extends more distal than the tibia, and thus prevents excessive eversion. The mechanism of injury for the lateral ankle sprain is characterized by the classic plantar flexion and inversion.

The extent of injury to the ligaments determines the severity of the sprain. A mild sprain is characterized by microscopic tears with no loss of ligamentous integrity. The application of additional forces may produce partial tears of the ligament, or a moderate sprain. Such injuries are significant, even though the tear is not complete. Severe sprains involve complete disruption of the ligament and associated functioning properties. While the American Medical Association uses the terms mild, moderate, and severe to classify the degree of injury, some programs refer to the degree of injury as a Grade I, Grade II or Grade III sprain.

The inversion sprain is more common than the eversion sprain because of the bony anatomy on the lateral side of the ankle, which tends to limit eversion. The most common mechanism of ankle sprains are plantar flexion and inversion. A single ligament tear usually involves the anterior talofibular ligament as it is stressed with plantar flexion. The anterior talofibular ligament has the weakest tensile strength of the lateral complex. The addition of inversion to the plantar flexed ankle may further affect the calcaneofibular ligament.

Intrinsic risk factors for sprains of the lateral ankle ligaments include a history of ankle sprains, generalized joint laxity (increased talar tilt), and delayed muscle reaction time. The most common risk factor for ankle sprains, however, is a history of sprains. Athletes with a previous ankle sprain have a 500-percent incidence of re-injury.

Therefore, a key factor in preventing and treating ankle injuries is understanding chronic ankle instability, which can result from mechanical instability or functional instability. Mechanical instability is easier to diagnose and treat because it involves a measurable degree of laxity. The ligaments no longer effectively support the ankle joint, making repeated sprains and instability more likely in normal daily activities. The athlete is aware of his or her symptoms and avoids any risky activity.

Functional instability is harder to understand (and there is less research on it) because of its subjective nature. Symptoms include lateral pain, difficulty walking on uneven surfaces, a feeling of weakness in the ankles, swelling, stiffness, and tenderness. Individuals have the sense that their ankles will give way if they take a wrong step. Functional instability has more to do with lost or diminished proprioception in the ankle. This type of ankle instability is the most difficult to diagnose and the most challenging to treat.

Hans Tropp, MD, PhD, is the foremost researcher on functional instability in ankles, and has found that decreased postural stability is not a function of mechanical instability, thus supporting functional training. He found soccer players with poor postural sway had a higher incidence of injury, and further reported improved postural sway in subjects with functional ankle instability following training on a balance board for six weeks.

To treat an ankle sprain, complete rehabilitation of all muscle groups is important, since eccentric invertor strength deficits may contribute to the symptoms of functional ankle instability. Weak invertors may contribute to functional ankle instability because they are less able to assist in controlling lateral displacement of the shank over the weight-bearing foot.

Overall, the gold standard today for preventing chronic ankle dysfunction is multifaceted. It includes an accurate and complete assessment, aggressive treatment and rehabilitation, addressing any underlying problems, and implementing a balance program to train proprioceptively.

TAPE IT UP

Prophylactic ankle taping has become one of the primary methods used to protect the lateral ligament complex. A review of the literature reveals prophylactic ankle taping techniques are warranted in high-risk sports. Interestingly, the literature is mixed regarding the exact mechanism through which these devices work and the effect they have.

Several studies point to the effective use of non-elastic tape to assist in the control of excess motion, to enhance performance, and for injury prevention. Authors also report athletic tape to be critical in the control of excess motion after an acute sprain.

Elastic tape has been found to have such characteristics as well, but with some conflicting studies. Most research looks at the use of taping in two key areas: First, does it provide mechanical resistance? And second, does it enhance or diminish performance?

At least five recent studies have found that ankle taping provides effective mechanical resistance to sprains. It does so by pulling from an area of strength along the proximal anchor across the weakened or injured area of the ankle back to the area of strength. Two papers explain that taping externally stabilizes the ligamentous structures and prevents joint hypermobility without significantly interfering with normal joint mechanics. Another finds that taping helps prevent the ankle joint from exceeding its physiological and biomechanical limits of motion. And two others say that prophylactic ankle taping decreases ankle motion against forces sustained during activity. Several authors found taping effective in controlling motion. One other said that taping specifically restricted plantar flexion and inversion motion, two frequent hallmarks of sprains.

Further studies say that taping provides support and stability to the ligaments and joint specifically in the chronic stage when the athlete returns to his or her sport. The research suggests that both mechanical and functional stability

of the ankle can be improved with taping (both athletic tape and cloth wraps were used with success).

Other studies have looked at the ability of tape to function well over time. A 1997 paper found taping to be virtually ineffective after periods of just 40 minutes. Four others felt ankle taping provided little support because the tape loosened with exercise. In 1973, The Journal of Sports Medicine discouraged taping due to the mobile nature of skin, the moisture that accumulates beneath tape, and disuse atrophy of ankle musculature. However, several authors felt that even though the restrictive effect of athletic tape may be lost over time, the neuromuscular and sensory mechanisms remain effective—ultimately, they may be of greater importance than the mechanical restriction of movement.

In terms of performance, most studies look at the effect of taping on the ankle's proprioception. In 1995, Robbins and colleagues assessed ankle proprioception and found the ability to determine the foot position of subjects with taped ankles was greater than over subjects with untaped ankles. Taping in particular helped mitigate decreases in proprioception brought about by wearing athletic shoes. Several factors likely contribute to this increase in proprioception. Taping appears to facilitate dynamic muscle stabilization of the ankle at least in part by improving peroneal muscle activation. Foot position sense is also improved by the deceleration of inversion provided by taping.

However, other studies have found different results. In 1972, two articles found that ankle taping decreased agility compared to no protection or using laced ankle stabilizers. The research also found ankle taping to restrict running and jumping activities.

A 1992 study reported that motor performance in taped and untaped subjects was not significantly different. In 1996, Verbrugge compared the effects of ankle taping and bracing on performance of agility drills, sprinting, and vertical jumps. Neither treatment affected the test results.

BRACED FOR THE WORST

Ankle braces are very popular today and come in many different styles. These various models are designed to provide external support and allow normal biomechanical motion and function.

In terms of acute injuries, a long list of studies have found orthotic devices effective as a chosen modality for treatment. More specifically, in 2002, Konradsen reported that orthotic braces used to treat acute Grade III lateral ankle ligament sprains were as effective as cast mobilization.

Many studies have found that ankle braces are effective at preventing ankle sprains and do not affect athletic performance. Tropp and colleagues evaluated the effect of an ankle orthosis on ankle injury incidence and concluded that bracing is effective at preventing ankle injuries. A group headed by Surve evaluated the effect of a semi-rigid ankle orthosis and found that it significantly lowered the incidence of sprains. Sitler, et al., evaluated the effect of a semi-rigid ankle orthosis and found a 3.5 times greater injury rate in un-braced subjects. This study also found that subjects had a generally positive attitude toward use of the braces. Further, Ubell reported braces are effective when landing on an object with one foot unexpectedly, forcing inversion.

Hughes and Stells found bracing combined with taping to effectively restrict foot and ankle motion. Various authors reported that brace utilization and high-top shoes combined with prophylactic taping results in fewer injuries. Others reported bracing combined with taping restricts motion, although these limitations did decrease force production and total work.

Rovere retrospectively reviewed laced ankle stabilizers with ankle taping over six years and found more than twice the number of initial sprains among the taped group—the effectiveness of the lace-up ankle brace in sprain prevention was statistically significant. Greene and Hillman compared the relative effectiveness of athletic tape and a semi-rigid orthosis in providing inversion-eversion range restriction before, during, and after a three-hour volleyball practice. There were maximal losses (41 percent) in taping restriction for both inversion and eversion 20 minutes into exercise.

FINAL FACTORS

Clearly, there is an expansive body of research on the use of ankle tape and braces in the prevention of athletic

injuries. And the research continues to evolve. It is evident that taping and bracing (or both) can protect an ankle from initial or subsequent injury. But which to choose and when should still be based on the individual athlete and provider preferences.

A question often arises on which is more cost efficient: tape or braces? Olmstead applied the "Numbers Need to Treat" analysis to previous ankle injury research and found that to prevent one ankle sprain in a game among athletes with ankle sprain histories would require taping 26 ankles. Further, 143 ankles would need to be taped among those without a history of ankle sprain to prevent one sprain. Based on these numbers, ankle bracing involves 50 percent the cost of taping over the course of a season. Thus, the use of ankle braces is usually a significant time and money saver for athletic trainers.

However, the choice must still come down to what works best in a specific situation. Braces can be effectively recommended for athletes during individual workouts when athletic trainers are not available for taping, while taping allows a more hands-on approach that can ensure the athletic trainer and athlete connect every day. Either way, the research supports supporting the ankle, however you choose to accomplish it.

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