The Role of Ankle Bracing for Prevention of Ankle Sprain Injuries

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Lateral ankle sprains are one of the most common injuries incurred in recreational and competitive athletics. These injuries have a significant impact in terms of cost, athletic participation, and activities of daily living. Prophylactic ankle braces are often used to reduce the risk of injury recurrence when individuals return to athletic participation. The purpose of this clinical commentary is to review the literature and provide our own experience relative to the use of prophylactic ankle bracing. Relatively high incidence rates of ankle sprain injury have been reported for basketball and soccer athletes, military trainees, and individuals with a previous history of ankle sprain injury. Semirigid and laced ankle braces have significantly reduced the incidence of initial and recurrent ankle sprain injuries in athletic and military samples. With few exceptions, these braces do not appear to affect functional performance adversely. The prophylactic use of semirigid ankle braces appears warranted to reduce the incidence of initial and, in particular, recurrent ankle sprain injuries for individuals who participate in activities that have the highest risk for these injuries. Additional research is needed to evaluate the many new braces that are available and in use and their influence on the incidence of ankle sprain injury and functional performance.


Key Words: brace, compliance, incidence, injury, orthosis, performance

The ankle joint is one of the most frequently injured anatomic sites for individuals who participate in recreational or competitive athletic activities, as well as for military personnel. Garrick and Requa reviewed injuries treated in a sports medicine clinic over a 6 1/2-year period and determined that 25% of 12,681 injuries occurred at the ankle and foot. Ankle sprains accounted for approximately 85% of the injuries to the ankle and foot region. These injuries can have a significant impact on routine daily activities, athletic participation, and military duties.

Ankle bracing has been a common clinical intervention to reduce the incidence of initial ankle sprain injury, provide protection following injury, and prevent ankle sprain injury recurrence. The purpose of this clinical commentary is to provide clinicians with information about bracing as a means for prevention of ankle injuries, primarily ankle sprain injuries. Issues that may influence the clinical decision-making process will be reviewed, including risk factors for ankle sprain injury, the influence of ankle bracing on incidence of ankle sprain, and factors that may affect patient compliance.

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RISK FACTORS FOR ANKLE SPRAIN INJURIES

Prior to recommending use of ankle braces to prevent ankle sprain injury, clinicians may first wish to identify individuals who are at greatest risk for this injury. Comparing the relative risk for ankle sprain injury across sports or occupation is difficult because of the different methods used to quantify risk. Some of these methods include number of injuries per 1000 athletic participations or 1000 parachute jumps, number of athletes experiencing an injury over 1 year or 1 season of sport participation, number of injuries per 1000 hours of sport participation, and percentage of injury incidence during a military training period.

In spite of the limitation of differing methods used to quantify risk of ankle sprain injury, important risk factors appear to be (1) the sport or work requirements that place individuals at risk for ankle sprain injury, and (2) previous history of ankle sprain injury. Surv et al reported an incidence rate of 0.86 ankle sprains per 1000 playing hours for male soccer players with a previous history of ankle sprain, and 0.46 ankle sprains per 1000 playing hours for previously uninjured ankles. Tropp and coworkers studied competitive adult male soccer players over a 6-month soccer season and reported 19 (25%) ankle sprains...
among 75 unbraced athletes who had a previous history of ankle sprain injury. The injury rate among previously uninjured soccer players was 11 (11%) sprains for 96 athletes. Sharpe et al\(^\text{29}\) reported an ankle sprain injury rate of 35% (6 of 17 ankles) among previously sprained ankles for female soccer players whose ankles were not braced during the course of a full soccer season.

Basketball and volleyball also may be sports with relatively high rates of ankle sprain incidence. McKay et al\(^\text{20}\) observed 10 393 recreational basketball participations and documented an injury rate of 3.85 ankle sprain injuries per 1000 participations. Players with a previous history of ankle sprain injury were 5 times more likely to incur an ankle sprain injury. Sitler et al\(^\text{30}\) reported a comparable rate for their study of 1601 recreational basketball players at the United States Military Academy at West Point. Ankle sprain injuries occurred at the rate of 5.2 per 1000 athlete exposures for unbraced players. Hosea et al\(^\text{17}\) studied 11 780 female and male scholastic and collegiate basketball players over the course of a basketball season and reported an overall ankle sprain injury rate of 8.6% among the athletes.

Additional evidence suggests that military personnel may be at risk for ankle sprain injury. Milgrom et al\(^\text{21}\) reported an ankle sprain incidence rate of 18% for 390 Israeli infantry recruits during the course of their basic training and identified a prior history of ankle sprain as a risk factor for ankle sprain injury. Among their unbraced control subjects, Schumacher et al\(^\text{28}\) reported an injury rate of 4.5 ankle injuries per 1000 parachute jumps and Amoroso et al\(^\text{1}\) reported an injury rate of 3.7 inversion sprains per 1000 jumps for their parachute trainees.

Potential risk factors for ankle sprain injury other than activity and previous ankle sprain injury have also been identified. Sex and level of competition may be risk factors, depending on the population under consideration. Hosea et al\(^\text{17}\) reported that female basketball players (n = 4940) had a 25% greater risk of Grade I ankle sprain injury compared with male basketball players (n = 6840). No sex difference was present for risk of sustaining Grade II or Grade III ankle sprains. In the same sample, the risk of ankle sprain injury was approximately twice as great for collegiate basketball players compared with high school athletes. Collegiate players (n = 868) had an ankle sprain injury rate of 15.8%, while the injury rate for high school players (n = 10912) over the season was 8.0%.

McKay et al\(^\text{20}\) also reported that basketball players who wore shoes with air cells in the heel were 4.3 times more likely to injure an ankle than those wearing shoes without air cells. This risk may be associated with increased deformation of the lateral aspect of the shoe’s heel during landing. If the player’s rearfoot is somewhat inverted during initial contact with the ground, deformation of the lateral aspect of the midsole and outersole material may move the ground reaction force vector more medially and increase the inversion moment arm for the ground reaction force.

One additional category of risk factor that has been addressed in the literature relates to anthropometry. Milgrom et al\(^\text{21}\) reported that military recruits who were taller and heavier were significantly more likely to incur a lateral ankle sprain injury. The authors attributed these anthropometric risks to a greater mass moment of inertia about the ankle joint, requiring greater resistance to inversion moments caused by ground reaction force during traumatic ankle sprain incidents. Although not identified as a risk factor in our literature review, we would suggest, based on clinical experience, that uneven ground surfaces also pose a risk factor for lateral ankle sprains for individuals who run for exercise, hike, or participate in sports on irregular ground surfaces.

As previously mentioned, identifying risk for ankle sprain injury is complicated somewhat by differing methods for reporting data. Among the studies we reviewed, the one method that appears most meaningful across different sports and activities is reporting incidence per 1000 hours of participation. We recommend that future investigations in this area use this particular reporting method. Standardizing incidence rates to a certain number of athletic exposures does not seem as useful, in that individual athletic exposures in some studies may be appreciably shorter than the duration of individual athletic exposures in other studies. An exception to this recommendation may be studies similar to those by Amoroso et al\(^\text{1}\) and Schumacher et al\(^\text{28}\), in which individuals are engaged in high-risk activities that are very short in duration, such as parachute jumps from an airplane. Reporting incidence rates per 1000 exposures (eg, per 1000 parachute jumps) may be more appropriate in such instances.

The literature that relates to risk factors for ankle sprain injury suggests that sports involving vigorous jumping, landing, and cutting maneuvers pose increased risk for ankle sprain injury. Additionally, all of the studies that have evaluated the risk posed by previous ankle sprain injury have documented previous injury as a serious risk factor. Individuals with a history of previous ankle sprains, therefore, are at increased risk for recurrence if they engage in some of the previously reviewed high-risk sporting activities, or if they hike or exercise on uneven terrain.

**EFFECTS OF ANKLE BRACING ON INCIDENCE OF ANKLE SPRAIN INJURY**

A central question related to the prescription of ankle braces is their ability to reduce the risk of initial ankle sprain injury or recurrence of ankle...
sprain injury. The results of several studies indicate that ankle braces can reduce the incidence of ankle sprain injury among soccer players. Tropp et al33 reported that a cloth and plastic ankle brace (Step 1; Patrick, Inc., Linkoping, Sweden) significantly reduced the incidence of ankle sprain injury among male soccer players. The investigators studied 60 athletes who wore this brace over a 6-month soccer season, as well as 171 control athletes who participated in the same soccer league. Thirty (17%) of the athletes in the control group incurred an ankle sprain, while only 2 (3%) of the athletes in the braced group incurred an ankle sprain. Among the soccer players with a previous history of ankle sprain injury, 19 (25%) of 75 control subjects incurred an ankle sprain injury, while 1 (2%) of 45 braced subjects incurred an ankle sprain injury.

Surve et al32 also studied male soccer players who reported a previous history of ankle sprain injury (n = 258) as well as those who reported no previous history of ankle sprain injury (n = 371). Players from each group were randomly assigned either to a control group or to a group that wore an Aircast Sport Stirrup (Aircast, Inc., Summit, NJ) ankle brace on the dominant leg (no previous history of injury) or their previously injured ankle(s). Among subjects with no previous history of ankle sprain injury, play over the season resulted in 32 ankle sprains in the braced group and 33 sprains in the control group. Among subjects who had a previous history of ankle sprain injury, however, only 5 braced ankles suffered ankle sprain recurrence, while 31 unbraced ankles suffered ankle sprain recurrence.

Sharpe et al29 studied 38 varsity female collegiate soccer players over a 5-year period. Of the 76 ankles, 56 had a history of previous ankle sprain injury. A canvas-laced brace (Swede-O Universal Ankle Support; Medical Specialties, Inc., Charlotte, NC) was worn during the season on 19 of these ankles without any ankle sprain recurrence. The ankle sprain recurrence rate for the 17 previously sprained ankles that were unbraced during the season was 35% (6 out of 17 ankles). Three (25%) of the 12 previously sprained ankles that were taped during the season incurred ankle sprain recurrence. Finally, 2 (25%) of the 8 previously sprained ankles that were taped and braced incurred ankle sprain recurrence.

Similar results have been reported for football and basketball players. Rovere et al25 studied 360 football players over 6 seasons of collegiate play. Athletic tape was worn by 233 football players while 127 football players wore laced ankle braces during the study period. The taped players incurred 159 initial ankle sprains (4.1 per 1000 exposures) and 23 ankle sprain recurrences (0.6 per 1000 exposures) during 38658 exposures to practice or games. The braced athletes incurred 37 initial ankle sprain injuries (2.8 per 1000 exposures) and 1 ankle sprain recurrence (0.08 per 1000 exposures) during 13273 exposures. Overall risk for ankle sprain injury for the taped group was 4.7 sprains per 1000 exposures and overall risk for the braced group was 2.9 sprains per 1000 exposures. Sitters et al30 took advantage of a captive audience of 1601 United States Military Academy cadets at West Point who were involved in the intramural basketball program. Subjects had a total of 13430 athlete exposures at either practices or games. Subjects who wore the Aircast Sport Stirrup ankle brace (n = 789) had one-third the number of ankle injuries (11 versus 35) compared with a control group (n = 812), although the severity of injury between the 2 groups was not significantly different.

Finally, paratroopers appear to have a high risk of ankle sprain injury for landings during training and airplane jumps.1,26 Schumacher et al28 studied members of an airborne Ranger battalion who either used a parachutist ankle brace for training or who were members of a control group. The brace was similar in design to the semirigid Aircast Air Stirrup brace, but was applied externally to the boots worn by the Ranger personnel. The braced group performed 5928 jumps and had an ankle injury rate of 1.5 injuries per 1000 jumps. The unbraced control group performed 7857 jumps and incurred 4.5 ankle injuries per 1000 jumps. Use of the brace resulted in 245 fewer days of medical restriction per 1000 jumps. Amoroso et al31 also studied 745 military recruits who completed a parachutist training program. Each recruit completed the training by performing 5 jumps from an airplane. Seven inversion ankle sprains were documented for 376 trainees who completed training without any ankle bracing. Only 1 inversion ankle sprain was documented for 369 trainees who wore an outside-the-boot ankle brace.

The previously reviewed studies suggest that semirigid ankle braces and braces consisting of relatively stiff cloth are capable of reducing the incidence of ankle sprain injury. Study samples for these research efforts have included professional, collegiate, club, and recreational athletes, as well as specialized military personnel. A relevant question may relate to how often these previously studied braces are used currently by patients. A new generation of braces has been manufactured recently. These braces are commonly prescribed by health care practitioners and procured by consumers on their own. These braces include: lace-up braces such as the Swede-O (Swede-O-Universal, North Branch, MN) and multiple models by McDavid Sports Medical Products (Woodridge, IL); lace-up braces with straps such as the ASO (Medical Specialties, Charlotte, NC), the RocketSoc (DonJoy Orthopedics, Inc., Vista, CA), and the Ankle Brace Lock (Breg, Vista, CA); and semirigid plastic braces with strapping configurations such as the Ankle Ligament Protector (DonJoy Orthopedics, Inc.), the Universal Ankle Stirrup (DonJoy Orthopedics, Inc.), and the RocketSoc (DonJoy Orthopedics, Inc.).
Orthopedics, Inc.), the T2 Active Ankle Support (Active Ankle, Louisville, KY), and the Ultra Ankle, and the Guardian Ankle (McDavish Sports Medical Products). Research is needed to assess the ability of these braces to reduce the incidence of new ankle sprain injuries, as well as the incidence of ankle sprain injury recurrence. A useful approach in this regard might be to survey clinicians first to determine which braces are most commonly used and then to conduct randomized prospective trials to compare the influence of these braces on injury incidence rates. Additional questions that might be addressed are:

1. How long should ankle braces be worn following an initial injury to decrease risk of ankle sprain recurrence sufficiently?
2. Does prolonged ankle brace use have adverse effects on muscle strength?
3. Do ankle braces place more proximal lower-extremity joints at risk for injury?
4. Is cost effective and practical to dispense ankle braces to all or most athletes who are engaged in high-risk athletic or work activities, even if some athletes have no previous history of ankle sprain injury?
5. Should the selection of ankle brace type be governed by the degree of ankle joint instability detected during clinical examination as well as risk for injury? For example, when we detect greater levels of residual ligamentous instability (2+ to 3+) and greater risk associated with activity, we tend to recommend semirigid braces such as the Aircast Sport Stirrup and Active Ankle Support. With lesser levels of residual instability (1+ to 2+) and lesser risk associated with activity, we recommend laced braces with strap configurations (the ASO and RocketSoc).

No research is currently available, however, to validate these recommendations.

FACTORS RELATED TO PATIENT COMPLIANCE

Ankle braces, therefore, can provide some protection against ankle sprain injury, but only if they are worn. Clinical experience suggests that athletes may not be compliant with ankle brace intervention if the brace is uncomfortable to wear or if they think or have hard evidence (eg, 40-m sprint time) that the ankle brace may have an adverse impact on performance. Early evidence regarding functional performance suggests that semirigid ankle braces do not adversely influence performance (ie, statistically equivalent results compared with unbraced testing) vertical jump height, sprint times, or agility run tasks. Many of these early studies, however, involved healthy subjects or samples of convenience from athletic teams with no requirement that subjects have a previous history of ankle sprain or demonstrate ankle instability.

More recently, Gross et al reported that the Ankle Ligament Protector and the Aircast Sport Stirrup semirigid ankle braces had no adverse effects on 40-m sprint times, a figure-of-eight run, or standing vertical jump height for 23 college-age subjects who reported 2 or more ankle sprains of the same ankle. Wiley and Nigg also have reported that use of the Malleoloc semirigid ankle brace had no negative effects on vertical jump height or figure-of-eight run times for 12 college-age subjects who reported a history of inversion ankle sprain and who demonstrated a positive anterior drawer test.

Adverse effects of ankle bracing on functional performance, however, have been reported in a few studies. Burks et al studied the effects of 2 laced ankle braces—the Kallassy Ankle Support (Kimberly-Clark Corporation, Milsons Point, Australia) and Swede-O Universal Ankle Brace—on broad-jump distance, vertical-jump height, shuttle run performance, and 40-yd sprint times for 30 varsity college athletes. Use of the Swede-O Universal Ankle Brace resulted in a statistically significant decrease in vertical-jump height (4.6%) and broad-jump distance (3.6%), and significant increases in sprint time (3.2%). Use of the Kallassy Ankle Support resulted in a statistically significant decrease in vertical jump height (3.4%). More recently, MacKean et al assessed the effects of ankle taping and the Swede-O Universal, Active Ankle, and Aircast Sport Stirrup braces on skill performance, oxygen uptake, and energy expenditure for a mix of 11 female collegiate, high school, and recreational basketball players. Jump shot performance was adversely affected by the Aircast Sport Stirrup brace (5.5 shots made of 10 attempted) compared with performance when subjects’ ankles were taped (7.2 shots made of 10 attempted). Oxygen uptake and energy expenditure during a 15-minute treadmill running task were significantly greater with use of the Aircast brace compared with treadmill running with ankles taped.

Hals et al are probably the first group of investigators to report enhanced performance resulting from ankle brace use. These investigators assessed the effects of ankle bracing for 25 subjects (mean ± SD age, 16.2 ± 6 years) who had a history of unilateral Grade I or II ankle sprain, and who demonstrated functional ankle instability as defined by performance on a modified Rhomberg test. Use of the Aircast Sport Stirrup resulted in significantly faster run times on a 9.14-m shuttle run task (mean ± SD time, 9.43 ± 0.72 seconds) compared with unbraced performance times (mean ± SD time, 9.57 ± 0.75 seconds). Brace wear had no significant effect on vertical jump task performance. Improved performance times for the shuttle run for the braced condition may be related to subjects being tested only 3 to 4 weeks following their ankle sprain injury.
Another issue that may be related to patient compliance is the degree to which an ankle brace is comfortable and avoids the formation of skin irritations such as blisters and excessive pressure. Any potential protection against ankle sprain injury may be lost if an ankle brace is not worn because of general discomfort or specific skin irritations. Two braces that have been compared in several studies with regard to comfort and perceived stability are the Aircast Sport Stirrup and the Ankle Ligament Protector. No consistent trends were noted across these studies with regard to comfort and perceived stability. Additionally, pressure points and blisters were noted with use of both braces in these studies. Patient comfort and the avoidance of skin disturbances from ankle brace wear may depend on the match between brace design and the specific anatomic structure of the individual patient.

Our clinical experience suggests that selecting an ankle brace to address the requirements related to ankle joint stability, functional skill performance, and comfort may be a matter of trial and error. Clinicians are encouraged not to abandon their recommendations for ankle bracing when patients who are at risk for injury are not compliant with brace use because of perceived or actual performance issues or discomfort. Softer braces (ie, laced braces with strap configurations) that may conform to differences in anatomic structure may address patient compliance issues in instances in which semirigid braces are uncomfortable or cause skin disturbances.

**CLINICAL IMPLICATIONS**

Clinicians should consider recommending use of ankle braces for patients who are at greatest risk for ankle sprain injury. These individuals include participants in recreational or competitive sports that require vigorous jumping, landing and cutting maneuvers, military personnel engaged in vigorous training programs or parachute jumping, individuals who have sustained previous ankle sprain injuries, and athletes involved in more competitive levels of participation. Semirigid and laced braces have reduced the incidence of ankle sprain injury in study samples from these target populations. Ankle braces generally have not had adverse effects on functional performance. Use of these braces, however, may be associated with skin disturbances such as blisters, or may be uncomfortable because of the anatomic fit of the particular brace with the specific anatomic structure of the individual patient. We advise clinicians to recommend ankle brace use for individuals who are at greatest risk for injury, and that several different braces should be evaluated if patients encounter adverse functional performance or discomfort with brace use.

**REFERENCES**


