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Ankle instability treatment focuses on postural control

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Interventions to improve postural control in patients with functional ankle instability include strength training, balance training, taping, bracing, and foot orthoses, but further research is needed to determine which therapeutic approaches work best in which patients.

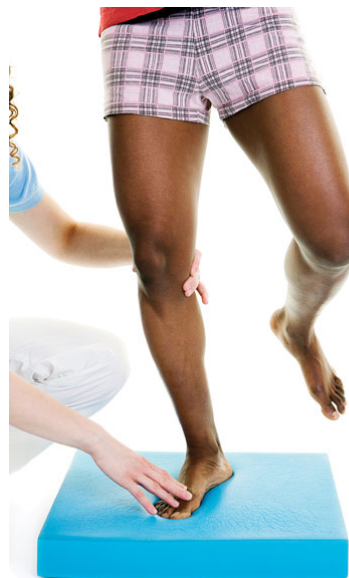
By Janet Simon, MS, ATC, Emily Hall, MS, ATC, and Carrie Docherty, PhD, ATC

Lateral ankle sprain is one of the most common injuries in both athletic and nonathletic populations.¹⁻³ Following a lateral ankle sprain, an array of residual symptoms and conditions can persist.

One of those conditions, functional ankle instability (FAI), characterized by recurrent ankle instability and the feeling of giving way,⁴ can be identified in 20% to 47% of people who have sustained an ankle injury.⁴⁻⁶ Many researchers have debated the exact definition of FAI, but most agree the term should be used to describe anyone with a history of an ankle inversion episode and residual symptoms, including giving way or continued bouts of instability.⁷

Postural control is the ability to stabilize the body during static standing or dynamic movements,⁸ while balance is often defined as a condition during which the body's center of gravity is maintained within its base of support.⁹ The ankle helps maintain the body's base of support and is an integral part of maintaining balance.¹⁰ In most cases, postural control deficits are associated with or secondary to decreases in neuromuscular control and proprioception.⁸ People with FAI often present with decreased strength, proprioception, and balance, which can affect the stability of not only the ankle joint, but of the entire body.¹¹⁻¹³

Previous studies reported the presence of FAI decreases postural control.^{11,14,15} Other studies, however, reported that postural control was not affected in individuals with FAI.¹⁶⁻¹⁸ Regardless, enough evidence exists to prompt researchers and clinicians to devise intervention programs to improve postural control and stability in the FAI patient population. Published intervention programs consist of strength, balance, plyometric, or combination training, as well as



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utilization of orthotic devices, taping, and bracing.

Balance training

Clearly, if the goal of a rehabilitation protocol is to improve balance, the first and obvious step would be to conduct some sort of balance training. Balance training can encompass a wide variety of exercises, from single-limb balancing tasks to more dynamic tasks, such as stability when landing from a hop. One common strategy for making a balance training protocol progressively more difficult is transitioning the participant from a stable surface to an unstable surface. This can be accomplished with wobble boards^{16,19} or ankle disks.^{19,20} Eils et al¹⁹ created a 12-exercise protocol that focused on multiple balance tasks on an array of surfaces. Each exercise created a different challenge depending on the relative stability of the surface. More recently, McKeon et al^{13,21} created a balance training protocol specifically designed to challenge the sensorimotor system. Exercises included single-limb hop to stabilization, hop to stabilization and reach, and unanticipated hop to stabilization.

Although these studies evaluated slightly different variables, all concluded that a four- to six-week balance training protocol improved aspects of postural stability in people with FAI.^{13,16,19-22}

The exact reason for these documented improvements is more difficult to ascertain. Researchers have proposed that, following a lateral ankle sprain, damage occurs to the sensorimotor pathways, so one explanation for observed improvements could be that balance training challenges and retrains the proprioceptive system.²² Another explanation is that balance training affects the relationship between shank rotation and inversion/eversion of the rearfoot, creating more stability in the joint.²¹

Not only is balance training associated with improved objective measures of stability, it also can improve self-reported ankle function. Two studies^{13,22} reported improvements in perceived ankle function following a four-week balance training program. Interestingly, the two studies used difference training protocols as well as different measures of self-reported function. Findings, however, were consistent.

Strength training

Another option for clinicians to consider is the use of strength-training protocols to improve postural stability. Many strength-training protocols focus on muscles at the ankle joint or lower leg. These muscles include the tibialis anterior, peroneus tertius, gastrocnemius, soleus, tibialis posterior, peroneus longus, and peroneus brevis.²³ With improved strength following training, balance might also be improved as a result of the stimulation that occurs to both the muscle spindles and golgi tendon organs.^{12,24} Published strength training interventions have focused on resistive tubing progressive training protocols (RTPTP)²⁵ and isokinetic dynamometer training.²⁴ Training is typically performed three times per



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week for six weeks.

A limited number of studies have looked specifically at strength-training protocols and postural stability, so conclusions should be made with caution. Inversion and eversion isokinetic strength training resulted in a significant improvement in balance.²⁴ The training was conducted in the concentric mode and consisted of three sets of 15 repetitions at 120°/s. Conversely, while some published studies have found RTPTP effective for increasing strength and proprioception,^{12,26} Powers et al²⁵ did not conclude that RTPTP was effective in improving postural sway.

We feel this discrepancy may be related to the amount of resistance used during training. The RTPTPs typically¹⁶ increase in resistance, sets, or repetitions every week and involve training in each of the four ankle directions (inversion, eversion, plantar flexion, and dorsiflexion).^{12,25,26} The amount of resistance provided by the tubing is critical to creating an improvement in strength or in any other measure. Previous research^{12,26} initiated training with a blue color (extra-heavy resistance) tubing and progressed to black (special heavy) and silver (super heavy) tubing, but Powers et al²⁵ progressed from red (medium resistance) to green (heavy resistance) and only used the blue tubing at the end of the protocol (weeks five and six).

Plyometric training

Plyometric, or agility, training protocols may be another means of improving balance in people with FAI, but, to date, researchers have done limited research on this topic. Agility training uses large and explosive movements to mimic sport-specific movements²⁷ and involves large shifts in the center of gravity, which may lead to improvement in postural sway.²⁸ Hess et al²⁷ investigated the effect of a four-week agility training program on balance in individuals with FAI but found no difference in static single-leg balance after the intervention.²⁷ There were a total of 20 participants; all had FAI. One group of 10 completed agility training; the other group of 10 did not complete any agility training.

One can identify several limitations in this study, which makes it difficult to extrapolate any clinical recommendations. The study had a relatively low sample size with 10 participants per group, and, after agility training, balance was measured only statically. Due to the nature of plyometric training, a more dynamic test of postural stability might have been more appropriate. Regardless, this is certainly an area of research that needs to be expanded before any definitive conclusions can be made.

Multicomponent rehabilitation intervention

Many studies have investigated the singular use of strength, balance, or functional tasks in an effort to improve postural stability. However, this section will examine only those rehabilitation protocols that included multiple components used concurrently; three known studies have tested the effectiveness of multicomponent rehabilitation protocols for improving postural stability.

One protocol used a combination of RTPTP and resistance band kicks three times per week for six weeks,²⁵ and a second consisted of range of movement exercises, resistance ankle exercises, balance training, and functional tasks for a total of six visits in addition to a home exercise program over four weeks.²⁹ The

final protocol involved a combination of four-way ankle exercises using manual resistance and a circular proprioception board three times per week for six weeks.³⁰

When utilizing clinical balance measures, two of the studies yielded improvements following the rehabilitation protocol.^{29,30} These clinical measures included: reach distance during the Star Excursion Balance Test (SEBT)²⁹ and the number of errors (times the board touched the ground) while balancing on a single-plane balance board (SPBB).³⁰ However, one of these two studies,²⁵ as well as the third study,²⁹ evaluated laboratory-based balance measures such as center of pressure values using a force plate, and no significant improvements were found for those measures.

Although one would expect the force plate to be a more sensitive measure of balance than a clinical test, generally the force plate only evaluates static balance. The static single-leg balance task might not have been challenging enough for the study participants to demonstrate post-training improvements.

The SEBT and SPBB are more dynamic in nature and more difficult to perform than the balance task, so they are more likely to improve with training. Based on these findings, we can conclude that a combination of strength and balance exercises is effective for improving dynamic balance, but as with any exercise protocol, it is important that the intervention and subsequent testing are rigorous enough to challenge the patient.

Taping and bracing

One method of reducing repeated ankle joint injury is through the use of external prophylactic support, such as ankle taping or bracing.³¹⁻³³

Two recently published studies investigated how ankle joint taping might affect postural stability in individuals with FAI.^{34,35} Sawkins et al³⁴ compared closed basket-weave taping, placebo tape, and a control condition (no tape) to improve performance on the SEBT and hopping drill. Hopper et al³⁵ used a fibular repositioning tape technique and analyzed force plate measures. Regardless of the tape application used, both groups of researchers concluded that taping did not improve postural stability in individuals with FAI. However, taping may still be effective for reducing ankle injury incidence and therefore should be utilized.³¹⁻³³

Recently, ankle braces have become a more prevalent method of preventing ankle injuries.³⁶ This change is due to long-term cost-effectiveness, ease of reapplication, maintenance of movement restrictions, and decreased risk of skin irritations compared with tape.³⁷ Previous researchers have shown that ankle bracing generally improves measurements of postural sway in individuals who are uninjured.³⁸⁻⁴⁰ Specifically, Feuerbach et al⁴⁰ reported that semirigid ankle bracing resulted in decreased postural sway during stance in healthy subjects (no FAI or previous ankle sprain). There is limited research in the FAI population; we found only one article⁴¹ in the literature that investigated the effectiveness of ankle bracing on postural stability in individuals with FAI.

Wikstrom et al⁴¹ investigated the use of soft and semirigid ankle braces on postural stability in individuals with FAI. Twenty-eight participants with unilateral FAI performed the dynamic postural stability index (DPSI) to evaluate postural sway; researchers recorded medial–lateral, anterior–posterior, and vertical

ground reaction forces after the jump landing. All individuals completed three conditions (control/no tape, semirigid, and soft ankle brace). The soft and semirigid ankle braces did not improve dynamic postural stability,⁴¹ but both braces helped with reduction of vertical forces. Since decreased postural stability is reported as a risk factor for ankle joint injury,⁴²⁻⁴⁴ further investigations are needed to evaluate the effects of taping and bracing on dynamic measures of postural stability.

Foot orthoses

The use of foot orthoses for the treatment of lateral ankle sprains has been reported in the literature.^{45,46} Early work hypothesized that foot orthoses reduced the magnitude of postural sway during various balance tasks in patients who had suffered an acute ankle sprain.⁴⁵ The authors theorized that stabilization of the subtalar joint by the orthoses added stability.^{45,46} As early as 1989, Clanton⁴⁷ anecdotally suggested that a laterally posted heel wedge should be utilized for conservative treatment of lateral subtalar instability. Hertel et al⁴⁸ conducted one of the first investigations on the use of orthotic devices in individuals who had sustained a lateral ankle sprain. They reported that orthotic intervention, regardless of type (i.e., shoe only, molded Aquaplast orthosis, lateral heel wedge, 7° medially posted orthosis, 4° laterally posted orthosis, and neutral orthosis), had no effect on improving postural sway measures.⁴⁸

More recently there has been a spike in the orthosis literature with regard to improving proprioception and postural stability in patients with FAI.⁴⁹⁻⁵² To properly evaluate orthotic devices as a possible intervention it is important to address the range of devices studied in the literature. Interestingly, investigators who used custom foot orthoses have found that postural stability improved.^{45,46,49,50} The use of prefabricated foot orthoses, however, has led to conflicting results and needs further evaluation.^{48,51,52}

The conflicting results may be attributed to use of an accommodation period; the one study that utilized an accommodation period with prefabricated foot orthoses found improvement in postural stability.⁵¹ Prefabricated foot orthoses are commonly used by clinicians because the neutral shell and deep heel cup allow for use in patients with a variety of foot types. However, the current literature supports only the use of custom foot orthoses for treatment of FAI. Future studies should focus on the long-term effects of orthosis use and investigate a variety of orthoses, including textured insoles.

Conclusion

Researchers have identified postural control deficits in individuals with FAI, and clinicians ultimately want to know which interventions to employ in the clinical setting to improve these deficits. Interventions used by clinicians include a variety of approaches, including strength training, balance training, multicomponent training, orthotic devices, and taping or bracing.

Further research is needed to support the use of any of these interventions in individuals with FAI. However, balance training, multicomponent training, and the use of custom foot orthoses stand out as being effective for improving postural stability in patients with FAI.

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