

Acute Ankle Sprains

Keys to Diagnosis and Return to Play

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In Brief: The diagnosis and treatment of acute ankle injuries present challenges to both primary care physicians and orthopedic specialists. Determining the position of the ankle when the injury occurred may help distinguish sprains from fractures so that unnecessary x-rays can be avoided. Stepwise rehabilitation restores function and diminishes the risk of reinjury. Physicians can stress functional measures of recovery to objectively assess readiness for return to play and balance the risks of incomplete rehabilitation against the desire for an early return to sports.

Ankle sprains are a common cause of lost playing time and disability among athletes (1). Despite many opportunities for physicians to become familiar with the evaluation of ankle injuries, distinguishing sprains from fractures and other important conditions can be difficult. The evaluation of ankle injuries may be simplified by understanding how anatomic factors dictate specific injury patterns. Sprains are most likely to occur when the ankle is injured in a position in which the bony architecture conveys little stability. Fractures are more likely when the ankle is injured in a position in which the bony structures have a greater role in providing stability. Differentiating the injury mechanism can help determine whether to order radiographs or to seek more specialized treatment or surgery.

The high number of recurrent sprains and the frequency of long-term complications from instability and arthritis suggest that the current management protocols may not be optimal. Athletes and coaches may regard ankle sprains as trivial and often fail to appreciate the risk of recurrent injury or chronic disability if rehabilitation is not completed before return to play. The pressure that athletes and coaches exert to return to play as soon as possible must be balanced with the need to ensure complete recovery.

Anatomy and Pathomechanics of Injury

Stability in the ankle comes from the bony architecture, ligaments, and musculotendinous structures (2,3). The talus articulates in a boxlike mortise formed by the distal tibia and fibula (figure 1). The lateral malleolus extends more distally than the medial malleolus, thereby providing a greater barrier to lateral displacement (eversion) of the talus. Because the talus is wider anteriorly than posteriorly, dorsiflexion locks the talus in the mortise

and results in a joint position of high bony stability. Further dorsiflexion or rotation in this position is likely to cause a malleolar fracture or disrupt the mortise by tearing the interosseous membrane.

Figure 1: Medical Art Services, Inc

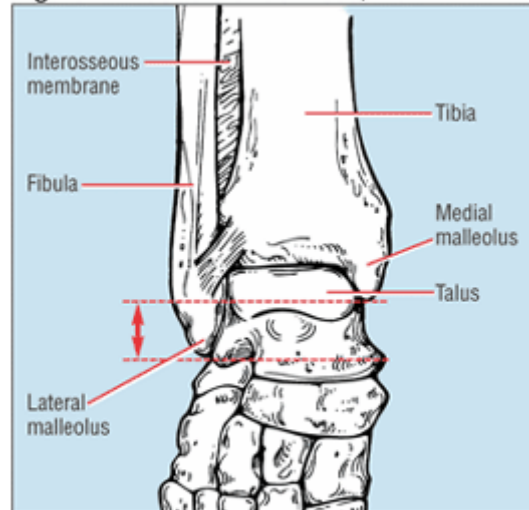


FIGURE 1. Anterior view of the ankle. Note the stabilizing boxlike mortise formed by the distal tibia and fibula over the talus. The lateral malleolus extends more distally than the medial malleolus (arrow). This creates a barrier to eversion, so most ankle sprains are caused by inversion.

When the ankle is in a position of low bony stability (plantar flexion, inversion), the ligaments have a more significant role in providing joint stability and are more likely to be injured. The lateral ligaments of the ankle include the anterior talofibular ligament (ATFL), calcaneofibular ligament (CFL), and the posterior talofibular ligament (PTFL). In plantar flexion, the ATFL assumes a vertical orientation and is the first ligament to be injured with inversion stress (figure 2). If the ATFL fails, the CFL can be sprained. The PTFL can be injured in conjunction with the ATFL and CFL but is rarely injured in isolation.

Figure 2: Medical Art Services, Inc

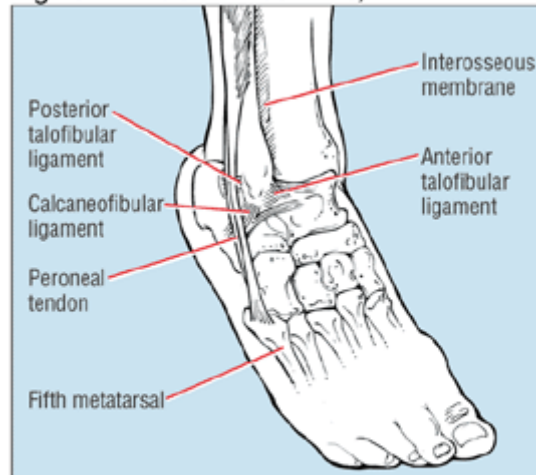


FIGURE 2. Forced inversion and plantar flexion of the foot disrupt the lateral ligaments of the ankle in severe sprains. The anterior talofibular ligament and the calcaneofibular ligament are the most frequently injured.

Identifying the components of the five-part deltoid ligament on the medial aspect of the ankle is less clinically relevant, because bony architecture (ie, the longer lateral malleolus) makes eversion sprains less likely. When tenderness, swelling, or instability is present on the medial aspect of the ankle, bony injury should be more strongly suspected.

The peroneal muscles resist inversion and can become injured in the process. Forceful contraction of the peroneals while the ankle is dorsiflexed can cause the peroneal tendons to subluxate or dislocate anteriorly across the lateral malleolus. The degree to which muscles provide stability is also affected by proprioception. With optimal proprioceptive function, the stabilizing muscles react more rapidly to inversion stresses (4). Impaired proprioception is associated with functional instability and recurrent sprains (5).

Patient History

Given the strong correlation between the mechanism of injury and diagnosis, identifying the joint position at the time of injury is a useful first step in the clinical evaluation. Patients might be confused by terminology such as inversion and eversion. They may also have different interpretations of phrases such as "turn in" or "turn out." Therefore, it may be clearer if the examiner shows the patient what is meant by the various terms or has the patient demonstrate the mechanism of injury with the uninjured ankle.

Revisiting the precipitating activity may help determine if the injury was unavoidable or resulted from inherent weaknesses. Jumping and landing on another player's foot or stepping in a rut on the field is likely to injure a previously normal ankle. Sprains that are unprovoked or occur in situations that wouldn't injure a normal ankle raise concerns for other diagnoses, such as tarsal coalition, osteochondritis, or peroneal tendon dislocation.

The history should include the location of pain, presence of swelling, and functional capacity, including the ability to bear weight, walk, run, and jump. A review of prior injuries, previous diagnostic studies, treatments, and any residual impairments should also be included. The patient's current sports participation history and training regimen help to gauge conditioning needs during recovery and requirements for return to play.

Physical Exam Clues

Evaluation of the uninjured ankle provides a baseline for assessing ligament stability and can help reduce apprehension during examination of the injured ankle. The exam of the injured ankle starts with an assessment of the degree and location of swelling and ecchymosis. Palpation should include bony landmarks such as the lateral malleolus, the medial malleolus, the fibula, the fifth metatarsal, and, in skeletally immature patients, the physis. Soft-tissue palpation includes the ATFL, CFL, PTFL, deltoid ligament, and peroneal tendon. Tenderness over the anterior joint line or syndesmosis may indicate a sprain of the interosseous membrane.

Testing for ligament laxity can be reliably done during physical examination (2). The anterior drawer test is specific for the ATFL and can be done with minimal pain or guarding. The talar tilt test is more likely to be limited by swelling and guarding, but the degree of CFL laxity is less critical for initial management of sprains. Tests for range of motion, strength, and proprioception are likely to be abnormal in the acute setting but may help assess deficits in patients who have chronic or recurrent sprains.

Various systems are used for grading the severity of ankle sprains. It is cumbersome to assign a grade 1 to 3 rating to each of the three lateral ligaments that may be injured. Some clinicians prefer to use the number of injured lateral ligaments to assess severity. An isolated sprain to the ATFL is considered a grade 1 (mild) sprain. A two-ligament injury involving the ATFL and CFL is a grade 2 (moderate) sprain. A grade 3 (severe) sprain indicates all three lateral ligaments have been injured.

Radiologic Evaluation

The decision to order radiographic studies should be based on the probability of finding bony abnormalities. When radiographs are indicated, the standard views should include anteroposterior, lateral, and mortise. The Ottawa clinical decision rules (3,6) were proposed as a means to reduce the number of unnecessary radiographic studies without sacrificing sensitivity for detecting fractures. Patients who are unable to bear weight and walk four steps in the emergency department, or who have bony tenderness over the malleoli, navicular, or fifth metatarsal, are good candidates for radiographic evaluation. X-rays are least likely to be warranted for patients who exhibit laxity of the ATFL without other clinical findings. Bone scans, magnetic resonance images (MRIs), computed tomography (CT) scans, and arthrograms all have diagnostic utility for specific injuries but have little role in the initial evaluation of ankle sprains.

Fractures. The probability of fracture can be predicted by identifying the joint position at the time of injury. When the joint is injured in a position of high bony stability

(dorsiflexion, eversion), there is a greater chance of bony injury. If the mechanism of injury is unclear, the location of maximal swelling and tenderness can implicate a probable injury mechanism. If the maximal swelling and tenderness is over the medial ankle, proximal to the malleoli, and/or along the interosseous membrane, a dorsiflexion injury should be suspected and a fracture should be ruled out.

Avulsions. Tenderness at the tip or anterior edge of the lateral malleolus may represent an avulsion of a ligament attachment. Small bony avulsions can be treated like a sprain; however, findings of tenderness on the malleolus that extends beyond ligament attachment sites, a palpable deformity, crepitation, or a tender physis warrants radiographic evaluation.

Talar lesions. Osteochondral lesions of the talus are often difficult to see on initial radiographs and may not be evident until a few weeks after the injury. Patients who have persistent joint pain or swelling should be considered for repeat radiographs--even if earlier studies were normal. Scintigraphy, CT, or MRI can detect and help characterize more subtle talar dome lesions.

Differential Diagnosis and Preliminary Treatment

The differential diagnosis of acute ankle injuries includes ligament sprains, tendon strains, and fractures of the malleoli, proximal fibula, fifth metatarsal, and distal fibular physis. A careful physical examination for bony tenderness or swelling in characteristic locations combined with the use of radiographic guidelines can minimize the chances of an overlooked fracture.

Lateral ligament sprains are the most common injuries caused by acute ankle trauma. Lateral ankle sprains can be adequately diagnosed by history and physical exam, and they can be effectively managed with nonoperative therapy (7-9), as discussed below.

Interosseous membrane sprains can occur when a dorsiflexed ankle (ie, locked talus) is rotated. Disruption of the interosseous membrane, also known as a high ankle sprain, can interfere with the integrity of the ankle mortise and cause chronic joint instability. If disruption of the tibiofibular syndesmosis extends proximally, it can cause a spiral fracture of the fibula neck known as a Maisonneuve fracture. Patients who have interosseous membrane injuries should be splinted initially, placed on crutches, and referred to an orthopedist for possible surgical stabilization of the mortise.

Peroneal tendon strains or dislocations are caused by an inversion mechanism that occurs most often when the ankle is in dorsiflexion, rather than plantar flexion. This injury may occur in a rigid, supportive structure, such as a ski boot. Patients with peroneal tendon injuries generally have pain and tenderness posterior, rather than anterior, to the lateral malleolus. If subluxation or dislocation of the peroneal tendon is present, patients will report instability that appears to exceed the degree of lateral ligament laxity. The examiner can often manually displace the tendon anteriorly or may elicit an anterior snap while the ankle is everted against resistance (figure 3). Peroneal tendon spasm combined with symptomatic ankle instability may be seen with a subtalar

tarsal coalition, and these patients generally do not have ligament laxity that is commensurate with their symptoms of instability.

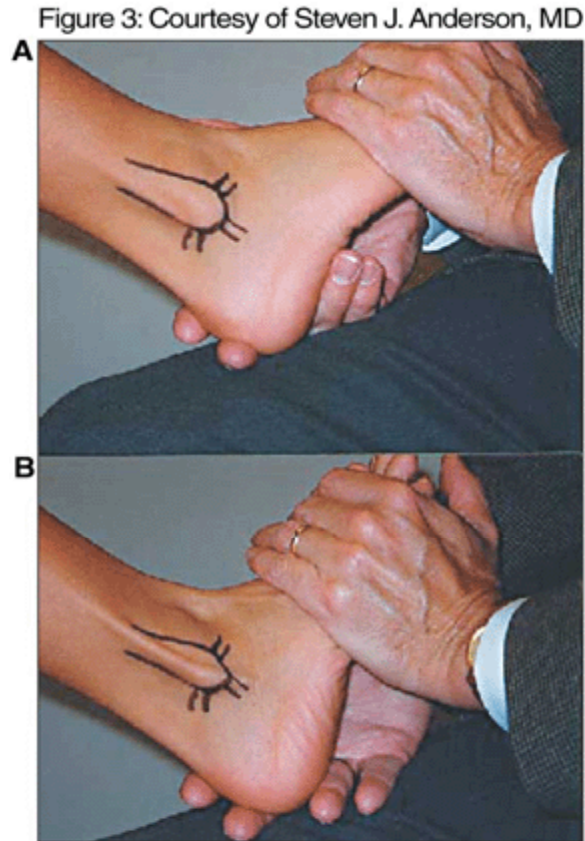


FIGURE 3. From a neutral position (A), a subluxated peroneal tendon may be displaced over the lateral malleolus or snap anteriorly when the examiner applies eversion against resistance (B). Tenderness is generally found posterior to the lateral malleolus.

Malleolar fractures or distal fibular fractures that are at or above the joint line may lead to a widened mortise and may require surgical reduction and fixation. Patients should be referred for surgical consultation with the ankle placed in a non-weight-bearing splint with crutches until a long-term treatment plan has been made.

Talar dome fractures are difficult to identify by history or physical examination. Tenderness over the anterior joint line, persistent pain with weight bearing, a clicking or catching sensation, or a lucency on a radiograph should raise suspicion for a talar dome fracture. Talar dome lesions should be evaluated by a specialist. Detached or displaced fragments may require surgery.

Fifth metatarsal fractures can occur with inversion of the ankle and foot. Avulsions of the peroneal brevis attachment are easily confused with apophysitis of the fifth metatarsal

(Iselin's disease). With apophysitis, a similar-appearing bony abnormality is found on the contralateral side. Both conditions can usually be treated conservatively. Fractures at the metaphyseal-diaphyseal junction (Jones fractures) may require surgical fixation.

Physeal fractures of the distal fibula may occur with inversion injuries. A tender, widened, but nondisplaced physis may require protection in a cast or splint and follow-up x-rays to confirm proper healing. A displaced or unstable physeal fracture may require surgical reduction and fixation. Again, comparison x-rays of the other ankle are often helpful in determining if bony changes are due to injury or normal variation.

Rehabilitation for Ankle Sprains

Successful treatment of inversion ankle sprains depends on establishing an accurate diagnosis and ruling out associated injuries or separate conditions. For inversion sprains, therapy can be divided into four phases. Each phase of treatment generally takes longer with more severe grades of injury, but the components of each phase are applicable for all grades of ankle sprain (10-12).

Phase 1 is directed toward reducing swelling, protecting the injured ligaments, and beginning weight-bearing activity. Ice, compression, and elevation may be used to control swelling. A felt horseshoe or doughnut with an elastic wrap can more effectively compress the recesses around the lateral malleolus. The ankle can be protected in a figure-eight brace, tape, ankle corset, or cast boot, depending on the severity of injury. The level of protection should allow the patient to begin weight bearing as soon as possible. Crutches may be necessary for pain-free ambulation in some patients, but prolonged immobilization or non-weight bearing have little benefit and, arguably, may have adverse effects on the patient's recovery.

Phase 2 begins when the swelling has subsided and the patient is ambulating without discomfort. The goal of phase 2 is to restore ankle range of motion and build strength in the surrounding muscles--particularly the peroneals. Active range-of-motion exercises include drawing the letters of the alphabet with the toes. Restoring full dorsiflexion is critical for regaining speed, explosiveness, and jumping ability. Dorsiflexion can be tested by having the patient do a one-legged squat with the heel touching the ground. Dorsiflexion of the uninjured ankle can be used for comparison.

Strengthening can be done with isometric exercises, manual resistance, or elastic tubing exercises. The peroneals compensate for laxity in the lateral ligaments and should be emphasized in the strengthening program. Pain or swelling associated with the exercises indicates that the patient is not ready for this phase of rehabilitation. When the resistance and number of repetitions performed with the injured ankle is equal to the uninjured side, the patient can progress to phase 3 of rehabilitation.

In the later parts of phase 2 and early parts of phase 3, most athletes are able to tolerate low-impact exercise. Weight lifting, swimming, cycling, stair climbing, and in-line skating can usually be done without compromising ligament healing or risking further injury.

Phase 3 exercises commence when joint motion and strength are back to normal. The goal of phase 3 is to restore the proprioception that is predictably lost with ankle sprains. Proprioceptive deficits may be increased by prolonged non-weight bearing or immobilization and may lead to further injury if not corrected (13). Proprioception can be measured by a modified Romberg test. The patient's ability to maintain balance on one foot is compared with the uninjured side. Proprioception can be restored by use of a balance board or exercises such as playing catch or brushing teeth while balancing on one foot. Braces or tape may be helpful, in part because of their proprioceptive input.

Phase 4 consists of functional progression from rehabilitation exercises to sport-specific skills. When all of the earlier phases have been completed, the patient may begin a return-to-running program that starts with jogging and progresses to running, sprinting, circles, figure eights, cutting, pivoting, and jumping. When all of these activities can be done without pain or limitation, the patient may be cleared to return to practice and, eventually, full participation.

Protection with taping or bracing during daily activity is recommended until strength returns to normal. When the patient is ready to start the functional progression, protective devices are recommended only during exercise and sports participation.

Compliance with and efficacy of the rehabilitation program may be enhanced if the patient is able to work with a certified athletic trainer or physical therapist. When a course of rehabilitation is prescribed during the initial evaluation of the injury, many important details of later care may be lost. Contact with a physician, physical therapist, or trainer during each of the four phases of rehabilitation can help ensure that patients are progressing at a reasonable rate and correctly performing exercises appropriate for their level of recovery. A well-designed rehabilitation program includes a clear plan for implementation, monitoring, and follow-up care.

Return-to-Play Criteria

Athletes typically want to know when they will be cleared for return to play. There are no foolproof criteria for accurately estimating recovery time. Recovery rates vary according to the severity of the injury, the effects from prior injury, the level and effectiveness of rehabilitation therapy, the motivation and compliance of the athlete, and the demands of the sport. The danger of arbitrarily assigning a date for return is that patient outcome and physician credibility may be compromised if the estimate is incorrect.

To minimize such risks, return to play can be linked with objective measurements of the patient's recovery and functional status. The rehabilitation checklist (see "[When to Return to Play After an Ankle Sprain](#)") can be used as a way to ensure that all rehabilitation goals are met and as a means for the patient and physician to measure progress. Patients can return to play when all the items on the checklist have been completed. The physician's job is to help the patient find ways to effectively meet the rehabilitation goals and to confirm that the goals for each phase have been satisfied.

Safeguarding the Ankle

Primary prevention focuses on preventing the initial ankle sprain, and secondary prevention focuses on preventing recurrent injuries. Static support (eg, taping, braces, or high-top shoes) and proprioception exercises increase neuromuscular response to inversion (14). No preventive strategy effectively eliminates all sprains. However, preventive measures and proper rehabilitation of injuries may reduce the frequency and severity of ankle injuries (15,16).

For more on specific exercise for ankle rehabilitation see the article "[Rehabilitating Ankle Sprains](#)" by Richard Sandor, MD and Scott Brone, PT, CSCS

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