8 Ankle sprain

8.1 Introduction

According to the American Academy of Family Practice, an estimated 1 million people in the U.S. visit a physician for an acute ankle injury each year. Ankle sprains are very common sports injuries but can also happen during everyday activities such as walking or even getting out of bed.

Ankle sprains occur with an incidence of one sprain per 10,000 people per day. They are the most common injury in professional basketball and are among the most common injuries in the National Football League (NFL) and collegiate football.

In this article, we discuss the diagnosis and treatment of acute ankle sprains, chronic ankle instability, and high ankle sprains (ie, tibiofibular syndesmosis injuries).

8.2 Anatomy

The ankle joint, a hinge joint, is composed of the tibio-talar articulation. It is stabilized laterally by the anterior talo-fibular ligament (ATFL) (Figure 1) and the calcaneofibular ligament (CFL) (Figure 2), medially by the deltoid ligament, and posteriorly by the robust posterior talofibular ligament (PTFL). The ATFL lies within the capsular layers but is a distinct structure. The CFL crosses both ankle and subtalar joints and lies deep to the peroneal tendons. Its orientation is in line with the superior peroneal retinaculum.
Superolaterally to the tibio-talar articulation lies the tibiofibular syndesmosis, defined as a fibrous articulation between the tibia and the fibula. The opposing surfaces are united by three ligaments, which include:

- Anterior inferior tibiofibular ligament (AITFL)
- Posterior inferior tibiofibular ligament (PITFL)
  - Superficial portion = obliquely from lateral malleolus to tibia; runs “upward”
  - Deep portion = more transverse; very strong
- Tibiofibular interosseous membrane/ligament
  - Membrane spans most of the length between the tibia and fibula
  - Acts as a mild restraint to external rotation

Some patients with ankle sprains also have an injury to the syndesmosis. This is usually, but not always, the result of an eversion and/or external rotation moment on the ankle at the time of injury. Athletes will often suffer a combined mechanism during a pile-up or tackle.

### 8.3 Clinical Presentation

#### 8.3.1 Acute Ankle Sprain
A thorough history, physical examination, and radiographs are usually all that is needed to evaluate an acute ankle sprain. Patients will often be able to recall the mechanism of their injury, which can give important clues as to the location and extent of injury. Patients usually describe an inversion-type twist of the foot followed by pain and swelling. An individual with an ankle sprain can almost always walk on the foot carefully with pain. The ability to walk on the foot usually excludes a fracture and indicates that a sprain has been experienced in an individual with normal local sensation and cerebral function. Grade III ankle sprains often include an audible snap followed by pain and swelling (see Staging below).

There is often swelling, ecchymosis, and tenderness over the lateral aspect of the ankle. Ankle motion can painful and the ankle appears to be in the normal anatomic position. A positive anterior drawer sign usually represents ATFL rupture. There is usually no tenderness over the lateral malleolus if there is no fracture of the bone. The degree of swelling or ecchymosis is proportional to the likelihood of fracture. Always assess peroneal tendons for stability. Recurrent sprains often have very little swelling.

### 8.3.2 High Ankle Sprain

The examination of a high ankle sprain is usually much different than the “classic” ankle sprain. These injuries generally have tenderness over the syndesmosis, but may also have tenderness over the lateral ligaments. Assess for medial (deltoid) tenderness and proximal fibular tenderness to rule out a maissoneuve injury (ie, high fibula fracture). Swelling and bruising may be minimal or late in appearance.

Tests specific for the high ankle sprain include the “squeeze test,” consisting of mid-calf compression (in absence of fracture) producing pain in the syndesmosis. This test has been found to be highly reliable. In Hopkinson et al's (1990) series, 9 of 10 patients with a positive test later developed interosseous calcification.

The external rotation stress test is performed with the patient sitting and produces pain in the syndesmosis with the foot and ankle externally rotated while the knee is held flexed at 90 degrees (Figure 3). With the patient standing, a single limb stance on the affected side with external rotation of the body will produce pain in the syndesmosis. Inability to perform a single leg heel rise may represent instability in the syndesmosis.

![Figure 3. External rotation stress test](image)

### 8.4 Pathogenesis
**Inversion ankle sprain.** Ankle sprains typically occur by an inversion injury. Patients will describe feeling their foot invert when landing or rolling over another athlete’s shoe. Occasionally, there is a component of dorsiflexion. Ankle sprains are graded by severity (Table 1, below).

**High ankle sprain.** The mechanism of a high ankle sprain is frequently variable and often poorly recalled by the patient, although it is generally different than classic inversion ankle sprain. The typical mechanism is thought to be an external rotation (outward) force on a foot fixed to the ground that is created by a direct impact to the leg above. The injury can also occur with dorsiflexion and inversion of the foot. This injury is more commonly associated with a fracture of the fibula (Weber C).

**Incidence of classic lateral ankle sprain.** It is estimated that there is one ankle sprain per 10,000 people per day. Ankle sprains are the most common injury in NCAA basketball and in the National Basketball Association (NBA). The majority of patients return to normal activity by 8 weeks after injury. Between 20% and 40% of patients suffering a Grade 3 ankle sprain have subsequent residual pain. Overall, there is an estimated 10% to 30% incidence of functional instability. Incomplete or inadequate rehabilitation is the most common reason for residual problems (loss of motion, proprioception, atrophy, peroneal tendinopathy).

**Incidence of high ankle sprains/syndesmotic injuries.** High ankle sprains, or injury to the tibiofibular syndesmosis, are relatively uncommon injuries, representing only 1% of all ankle sprains. Boytim (1991) reported 15 high ankle sprains over a 6-year period in a professional football team, with significantly more time lost from competition compared to classic lateral ankle sprains. Hopkinson (1990) reported 15 high ankle sprains over 3.5 years in West Point cadets, representing about 1% of all ankle sprains in that period. Recovery time was almost twice that for the classic ankle sprains (28 days compared with 55 days). The NFL has seen a recent increase in the incidence of syndesmosis injuries. This has been attributed by some to an evolution in shoe wear, with lighter weight cleats, more mid-foot bend, and new cleat designs. The current playing surface (turf) may also contribute since the cleat may lock deep into certain surfaces more than others.

While the large majority of ankle sprains will result in full recovery for the patient, many (estimated between 20% and 40%) patients experiencing ankle sprains will suffer recurrent sprains and ultimately chronic instability (DiGiovanni et al, 2004). Chronic ankle instability may also lead to progressive osteoarthritis of the ankle, although the link has not been rigorously proven.

### 8.5 Classification (Staging)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
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<tr>
<td>I</td>
<td>The ATFL is stretched and some of the ligament fibers are torn. No frank ligamentous disruption is present. Mild swelling, little or no ecchymosis on the lateral aspect of the ankle / point tenderness on the ATFL / and no or mild restriction of active ROM. Difficulty with full weight bearing is sometimes seen. No laxity on examination.</td>
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II Moderate injury to the lateral ligamentous complex, frequently with a complete tear of the ATFL ±
partial tear of the CFL. Restricted ROM with localized swelling, ecchymosis, hemorrhage, and
tenderness of the anterolateral aspect of the ankle. Abnormal laxity may be mild or absent. May
be indistinguishable from a grade III injury in the acute setting.

III Complete disruption of the ATFL and the CFL ± capsular tear ± PTFL tear. Diffuse swelling,
ecchymosis on the lateral side of the ankle and heel, and tenderness over the anterolateral
capsule, ATFL, and CFL.

IIIA* Decrease in ROM >10°, edema >2 cm, and normal stress radiographs.

IIIB* Decrease in ROM >10°, edema >2 cm, and >3 mm difference in distance between the posterior
articular surface of the tibia to the nearest point of talus on radiographic comparison of the
uninjured and injured ankle.


8.6 Imaging

In general, weight-bearing AP, lateral, and mortise radiographs of the injured ankle to rule out fracture
(Figure 4a). However, according to the Ottawa ankle rules, radiographs are not indicated if there is no bone
tenderness and the patient is ambulatory.

If a high ankle sprain is suspected, the radiograph should include the upper leg to assess for bony injury (eg,
maissoneuve injury) or gross syndesmotic disruption. Frank syndesmosis diastasis is rare without a fracture
or applied stress. Avulsion fractures can occasionally be seen on the lateral view, and indicate capsular or
ligamentous avulsion. AP and mortise views are assessed for increased medial clear space (> 6 mm).
Interosseous calcification of this syndesmosis can be visible after 6 weeks.

Stress radiographic views (Figure 4b) have no prognostic value for the “classic” inversion injury; however,
they may be beneficial in high ankle sprains. For a high ankle sprain, stress views are performed by applying
external rotation and lateral displacement stresses to the injured ankle, assessing for separation between
tibia and fibula. These should be compared to the contralateral uninjured ankle since there is variability in
soft tissue laxity between patients.
Magnetic resonance imaging (MRI) is very sensitive for ligamentous and syndesmotic injuries but is not predictive of instability. This test is not indicated for acute classic inversion injury unless peroneal tendon or intra-articular injury is suspected. In the elite athlete with a high ankle sprain, an MRI can be an important prognostic tool to guide time out of sports and the timing of rehabilitative exercises. MRI is also helpful when patients are unable to tolerate adequate stress testing. Bone scans have been found to be sensitive for ligamentous/syndesmotic injury but cannot determine the extent or degree of injury as well as MRI. Computed tomography (CT scans) are rarely indicated in the acute ankle sprain, but may be useful for chronic instability and when assessing for associated bony injury and healing or arthritis (Harper, 2001).

8.7 Conservative Treatment

8.7.1 Acute Ankle Sprain

Treatment of the acute classic inversion injury consists of RICE (rest, ice, compression, elevation), early protected weight-bearing, and when comfortable, physical therapy for peroneal strengthening and proprioception. This can be done with formal physical therapy or a well-directed home program in the motivated patient.

Return to play can be allowed when the patient is able to perform position-specific drills with external protection (taping or bracing). If patients have persistent pain, swelling, and activity limitations or reach an unacceptable plateau after 6-8 weeks, repeat radiographs or an MRI is indicated. Surgery is very rarely indicated for an acute lateral ankle sprain.

Below is a useful algorithm for the care of these injuries.
8.7.2 Chronic Lateral Instability

When evaluating the patient with lateral instability, it is important to define the origin and extent of instability. In general terms, this can be defined as isolated lateral (tibiotalar) instability, isolated subtalar instability (often manifest with sinus tarsi syndrome), or combined ankle and subtalar joint instability.

Before considering surgical intervention, it is vital that all nonoperative and rehab measures are exhausted. Ensure that the patient has been compliant with bracing and taping and that he/she has undergone sufficient proprioceptive training, peroneal strengthening, and Achilles stretching. Shoe wear modifications and orthoses can also be useful.

8.8 Operative Treatment

Surgical reconstruction is very successful in patients with persistent mechanical or functional instability (persistent giving way). Surgical indications include:

- Failure of nonoperative care
- Inability to brace (skin problems/work issues/dancer)
- Recurrent sprains with daily activities

It is important to consider that any procedure that stabilizes the subtalar joint will also reduce the joint’s ability to compensate to uneven terrain. Also consider the patient’s mechanical axis: A varus ankle or hindfoot should be recognized and corrected to avoid risk of recurrence.

There are a multitude of described ligament reconstructions. The modified Brostrom remains the gold standard as an initial operative treatment. This consists of an anatomic repair of the local attenuated tissues. Consider an augmentation or free graft reconstruction (ie, split Evans procedure, Figure 5) in heavier and higher-demand individuals. Arthroscopic exploration can be a helpful adjunct in cases of intra-articular pain or pathology (ie, OCD or loose body). Return to play is generally 4-6 months depending on the patient’s recovery and sport/position.
Patients with clinical signs of syndesmotic injury without radiographic findings of stress instability are treated non-operatively. This consists of weight-bearing as tolerated in an ankle device that limits external rotation. The ability to perform a 15-step single-limb hop test is useful to determine safe return to athletics. In general, these injuries require about twice the recovery time of a “classic” lateral ankle sprain.

Patients with instability on stress testing typically require a non-weight-bearing cast for 4 weeks followed by a walking cast for 2-4 weeks. Serial radiographs can be helpful to ensure there is no diastasis. In elite level athletes, early screw fixation can be considered for improved rehab and quicker recovery. An alternative to a screw is a suture-tensioning device, which may offer stability to the syndesmosis without concern for screw breakage or need for subsequent removal.

Patients with gross diastasis of the syndesmosis require reduction and fixation of the syndesmosis. Two screws is the preferable method of fixation although the suture-button is becoming more popular. In general, recovery is much longer for these injuries (approximately 4 months on average).

Screw removal. Removal of syndesmosis screws may not be necessary as this has not been associated with improved outcomes in studies of fracture-associated syndesmosis fixation. However, in athletes the natural motion of the syndesmosis is an important part of optimal ankle function and the screws frequently break if not removed. This can make subsequent screw removal much more difficult. This may be an issue if there is hardware-associated pain. Timing of screw removal is generally 10-12 weeks after fixation, but a longer period may be required in purely ligamentous injuries. Return to full contact activity generally occurs 4-8 weeks after hardware removal. Additional considerations in fixation of the syndesmosis include use of a suture-tensioning device instead of screw fixation. Also, a fibular plate may be useful to neutralize stress risers after syndesmotic screw removal (Figure 6).
Figure 6. A fibular plate may be used after syndesmotic screw remove to neutralize stress risers

### 8.9 Postoperative Care

Although post-operative protocols vary with the type of repair or graft used, a standard Brostrom/Gould reconstruction is placed in a non-weight-bearing splint in slight plantar flexion and eversion for a period of 2 weeks. Subsequently, a weight-bearing cast is used for 2-3 weeks in the neutral position.

After cast removal, the patient is provided with CAM walker boot and exercises are initiated. Formal physical therapy is generally recommended, especially for elite athletes. The patient is transitioned to an off-the-shelf ankle brace, and a program of range of motion and peroneal strengthening is initiated.

Inversion is generally avoided for up to 12 weeks. In-line running may begin at 8-10 weeks, beginning with an anti-gravity treadmill or deep-water jogging. Cutting activities are avoided until 14-16 weeks. Sport-specific conditioning and gradual return to sport usually occurs at 4-5 months post-op, depending on the athlete and the requirements of their sport and position.

### 8.10 Outcome

*Prognosis — lateral ligament reconstruction*. Very good functional results have been reported in approximately 90% of patients undergoing Brostrom/Gould ligament reconstruction, with radiographic evidence of less residual laxity. The results are less satisfactory in patients who have generalized hypermobility of the joints or long-standing ligamentous insufficiency (>10 years), as well as in those who have undergone previous ankle joint ligament surgery. Anatomic repair using the original ligament is technically simple, giving rise to few complications, and producing short- and long-term satisfactory functional results.

*Prognosis — syndesmotic injuries*. There are very little data on outcomes after surgical repair of the syndesmosis. Most authors report good results with or without surgery in the short term. Fritschy (1989) reported that only 1 of 10 World Cup skiers had residual pain after treatment for high ankle sprain; all returned to full athletic activity. There is a high incidence of heterotopic ossification/calcification between the tibia and fibula, but this has no correlation to late symptoms. These patients can be treated with a diagnostic and therapeutic injection of the syndesmosis. If the injection initially relieves pain but the pain subsequently returns, debridement or fusion of the syndesmosis may be considered. Recovery after this procedure may take 6-12 months.

### 8.11 Complications

Complications associated with ligament reconstruction include wound healing problems, infection, sural nerve injury, failure of ligament healing, and deep vein thrombus. When using a tendon augmentation procedure (as in the Evans procedure), motion can be reduced at the subtalar joint. This can be advantageous in populations or individuals with subtalar joint laxity.

### 8.12 Controversy
Identifying associated pathologies. Lateral ankle instability itself is not painful. However, there is a very high incidence of associated injuries that can contribute to activity-related pain in patients with acute or chronic instability. Some of these injuries are outlined in Table 2. When one or more of these injuries is suspected based on the history or clinical evaluation, further testing and imaging may be indicated, including MRI, bone scan, CT, EMG/NCS, and injections (fluoroscopic or ultrasound-guided). Associated pathologies can be addressed at the time of surgery.

Table 2. Associated Injuries

Intra-articular Injuries

- Osteochondral lesion of talar dome or distal tibia
- Loose bodies
- Synovitis of the tibiotalar joint

Bony Injuries

- Posterior talar process or os trigonum
- Fifth metatarsal
- Lateral talar process
- Anterior calcaneal process
- Fibula
- Epiphysis (in children)

Soft tissue Injuries

- Sinus tarsi syndrome (interosseous ligament/synovitis)
- Impingement syndromes (bony/soft tissue)
- Tendon disorders
- Peroneal tears
- Peroneal dislocation/subluxation

Nerve Injuries

- Stretch injury to nerve (SPN, sural)
- Chronic regional pain syndrome – type 1 (RSD)

Arthroscopic exploration. Arthroscopic exploration of the ankle may be considered in the presence of OLT (osteochondral lesion of the talus), loose bodies, synovitis, or bony or soft tissue impingement. Subtalar arthroscopy should be considered with sinus tarsi syndrome, loose bodies, or synovitis in the subtalar joint. Pre-operative advanced imaging studies (MRI, bone scan, injections) can be an important guide to the site of pathology.

Treating associated tendon pathologies. Peroneal tendon dysfunction and loss of dynamic support may be addressed at the time of addressing ligament instability. If both peroneals deficient but muscle is adequate, perform allograft/autograft. If both peroneals are deficient and weak, consider tendon transfer (FHL). In the presence of a split tear of the peroneus brevis, the anterior slip of the tear can be extended and used as the split tendon graft.
8.13 References