Ankle ligament injuries

Ankle ligament injuries in the presence or in the absence of fractures are common. They often present a diagnostic challenge, and their management is poorly understood and subject to debate. This article reviews and discusses the current literature on the management and diagnosis of these injuries.

Soft tissue injuries about the ankle are common and comprise a large proportion of emergency and musculoskeletal referrals. Ankle injuries are also frequent in almost all sporting activities. A review of a total of 227 studies reporting injury pattern in 70 sports has shown the ankle to be the second most common injured body site after the knee, and ankle sprain the most common type of ankle injury (Fong et al, 2007).

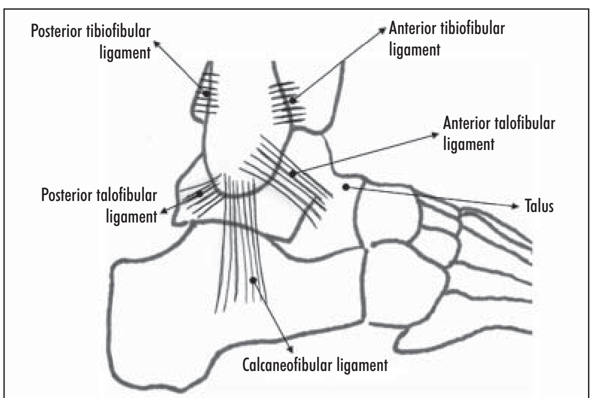
Anatomy

The stabilizing ligaments around the ankle can be broadly categorized into three main groups:

1. Lateral ligaments which includes the anterior talofibular ligament, the calcaneofibular ligament and the posterior talofibular ligament (*Figure 1*).
2. Medial ligaments which are essentially all components of the large medial deltoid ligament. This is a broad ligament consisting of two components. The superficial deltoid attaches the tip of the medial malleolus to the calcaneus, the spring ligament and the navicular. The deep deltoid ligament runs from the medial malleolus to the talus and together with the superficial ligament acts to prevent talar adduction and external rotation.
3. The distal tibiofibular syndesmosis which acts to stabilize the ankle mortise. This comprises the anterior and posterior tibiofibular ligaments and the adjoining tibiofibular interosseous membrane.

The lateral ankle ligaments are the most commonly injured structures. The anterior talofibular ligament acts as the principal 'lateral collateral' ligament of the ankle with the ankle in plantarflexion while the calcaneofibular ligament becomes taut with the ankle in dorsiflexion (Bahr et al, 1998). This explains the relative high frequency of injuries to the anterior talofibular ligament with forced inversion and plantarflexion of the ankle. With increasing force a combined injury to the anterior talofibular ligament and calcaneofibular ligament may result. In fact anterior talofibular ligament injuries alone or in combination with a calcaneofibular ligament injury comprise around 85% of all ankle sprains (Gerber et al, 1998). Isolated injuries to the medial and syndesmotic ligaments in the absence of a fracture are less common, but they should be ruled out after a careful assessment of the injured ankle.

Figure 1. Anatomy of the lateral ankle ligaments.



Lateral ligament sprains

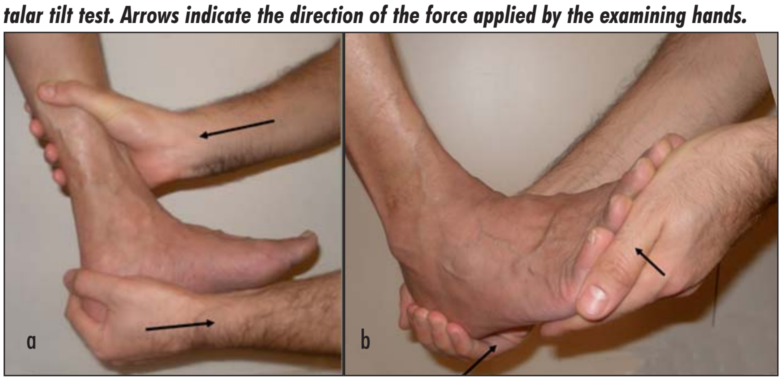
History should focus on the position of the foot and the direction of the force at the time of the injury, the location of any pain or swelling and a history of any previous ankle injuries and subsequent ankle instability.

On examination any tenderness, swelling or ecchymosis just anterior to the distal fibula (anterior talofibular ligament) or just distal to the tip (calcaneofibular ligament) may suggest injuries to the corresponding ligaments. Instability can be assessed using one of two tests (*Figure 2*) and compared to the contralateral ankle.

Anterior drawer test

The anterior drawer test is performed with the patient relaxed and the knee flexed, preferably sitting with both legs hanging from the edge of the examining table. The examiner places one hand proximal to the ankle stabilizing the distal tibia (and exerting a posteriorly directed

Figure 2. Clinical assessment of ankle stability with (a) the anterior drawer test and (b) the talar tilt test. Arrows indicate the direction of the force applied by the examining hands.



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force) and the other grasping the hindfoot and exerting an anteriorly directed force. Both ankles must be examined in the same position as the degree of plantar or dorsal flexion will affect their relative stability. A talocrural laxity which is 3–5 mm greater than the opposite side suggests an injury to the lateral ligaments. It has been suggested that an anterior translation around 4 mm is accepted as normal, 6 mm suggests an isolated anterior talofibular ligament rupture and 9 mm can be caused by the failure of both the anterior talofibular ligament and the calcaneofibular ligament (Kerkhoffs et al, 2001). If instability is noted with the ankle in neutral, the test should then be repeated with the ankle in different positions. If an anterior-posterior drawer test shows less laxity in dorsiflexion than in neutral, then an isolated anterior talofibular ligament tear exists. Laxity in all positions suggests a combined injury (Hollis et al, 1995).

Talar tilt test

The talar tilt test is performed by exerting an everting force to the hindfoot and assesses the integrity of the calcaneofibular ligament. The patient remains in the same position as for the anterior drawer test. The examiner places one hand underneath the patient's forefoot to dorsiflex the ankle thus placing the calcaneofibular ligament under tension (see above and Bahr et al (1998)). The examiner's other hand grasps the patient's heel, exerting an everting force to it. Increased laxity on the affected side suggests an injury to the calcaneofibular ligament.

Syndesmosis injuries

Tenderness over the anterior ankle at the level of the distal tibiofibular joint or pain at the syndesmosis with compression of the tibia and the fibula proximal to the syndesmosis (squeeze test) suggest a syndesmotic sprain. These injuries are more common in association with fractures and can be suspected by evaluating the biomechanics of the injury and applying the Lauge-Hansen classification system (Lauge-Hansen, 1950). Isolated injuries to the syndesmosis are rare and they are more likely to present with an accompanying malleolar fracture.

Weber's classification of fibula fractures can be helpful in suspecting an injury to the syndesmosis: fractures below the syndesmosis are Weber A, those at the level of the syndesmosis are Weber B and those above the syndesmosis Weber C. A fibula fracture above the level of the syndesmosis (Weber C) should alert the clinician to the possibility of a syndesmotic disruption. A high Weber C fibula fracture (more than 5 cm above the joint line) should be treated with syndesmotic stabilization. Treatment of low Weber C injuries, however, is more controversial. In a randomized study by Kennedy et al (2000) stabilization of low Weber C fractures with a screw had no significant functional or symptomatic effect on outcome. The authors suggested that obligatory fixation of these fractures with syndesmotic screws appears to have no benefit and leads to an additional procedure. However, Snedden and Shea (2001) noted anatomical variations in the attachment of the syndesmotic ligaments in their cadaveric study and concluded that a diastasis can still occur in the presence of a low fibula fracture. The authors therefore recommend that in low Weber C fractures and in Weber B injuries the syndesmosis should be assessed at the time of surgery and with stress radiography and syndesmotic stabilization performed only if indicated.

The syndesmosis remains intact in Weber A injuries and stabilization is not required.

Medial ligament injuries

Isolated injuries to the medial deltoid ligament are rare. However, injuries to the deep component of the deltoid ligament when in association with lateral sprains or fibular fractures are more common than generally recognized. In one study a third of patients presenting with an isolated fracture of the fibula demonstrated deep deltoid tears at arthroscopy (Schuberth et al, 2004).

The abnormal widening of the medial clear space has often been used to diagnose deltoid incompetence. When, at the time of surgery, stress radiography with the ankle in dorsiflexion and external rotation is performed medial clear space of 5 mm or more is suggestive of deep deltoid ligament disruption (Park et al, 2006). Widening of the medial clear space in static radiographs, however, has been shown to be an unreliable indicator for deep deltoid rupture (Schuberth et al, 2004) and a high degree of clinical suspicion is therefore advocated. Tenderness and swelling over the medial ligaments should raise the possibility of a deltoid injury. High grade instability is best treated with open repair of the injured ligaments. This may require bone anchors to reattach the deltoid to the medial malleolus. Occasionally reduction of the mortise may be hampered by the ruptured ligament trapped within the medial aspect of the joint, in this situation open exploration of the medial side and the consequent repair of the ligament must be undertaken.

Occasionally the medial injury can go unnoticed acutely and the patient presents with posteromedial pain and impingement at a later date, a condition often referred to as posteromedial impingement syndrome. This is a result of injury to the posterior fibres of the deep deltoid ligament which become crushed between the medial wall of the talus and the medial malleolus (Paterson and Brown, 2001). Magnetic resonance imaging (MRI) can be helpful in diagnosis and demonstrates capsular thickening and synovitis of the posteromedial structures (*Figure 3*).

Investigations

Plain radiographs help to rule out any associated fracture. Anteroposterior (AP) as well as AP with internal rotation (mortise) and lateral views should form the basic screening views. Stress views while performing an anterior drawer or a talar tilt can be useful adjuncts in

Figure 3. Magnetic resonance imaging of the ankle demonstrating posteromedial thickening and synovitis resulting in an impingement syndrome.

diagnosing a lateral ligament rupture. The relationship between the distal tibia and fibula or any evidence of diastasis should be sought on both the AP and mortise films (*Figure 4*).

A diastasis should be suspected if the distance between the incisura of the tibia and the medial aspect of the fibula on the AP film is greater than 5 mm at a point 1 cm above the joint line or if there is a tibiofibular overlap of less than 1 mm on the mortise view (Harper and Keller, 1989). In a true mortise view widening of the medial clear space when compared to the superior tibiotalar joint space suggests a talar shift and instability of the mortise. Interpretation of plain radiographs in the diagnosis of a distal tibiofibular diastasis is particularly challenging. In one study sensitivity of radiographs was 31% and the specificity was 83% when postoperative reduction of the syndesmosis was compared to a computed tomography (CT) scan (Gardner et al, 2006). The authors advised heightened vigilance for assessing accurate syndesmosis reduction intraoperatively rather than purely relying on radiographs.

This has led to some advocating stress radiography to detect a syndesmotic injury (Jenkinson et al, 2005). Outpatient stress views can be difficult to reproduce, but are often used for research when special equipment is available (the TELOS arthrometer). At surgery this should include an adduction and external rotation test as well as the traditional 'hook test'. The hook test is performed intraoperatively and at the time of internal fixation when the injury is associated with a fracture. A bone hook is placed around the distal fibula and the fibula is translated away from the distal tibia. This test is best performed in both the sagittal and the coronal planes and the distal tibiofibular syndesmosis assessed on AP and lateral radiographs (Candal-Couto et al, 2004). Preoperatively MRI remains a powerful diagnostic tool and is sensitive in detecting ligament injuries around the ankle (Liou and Totty, 1991).

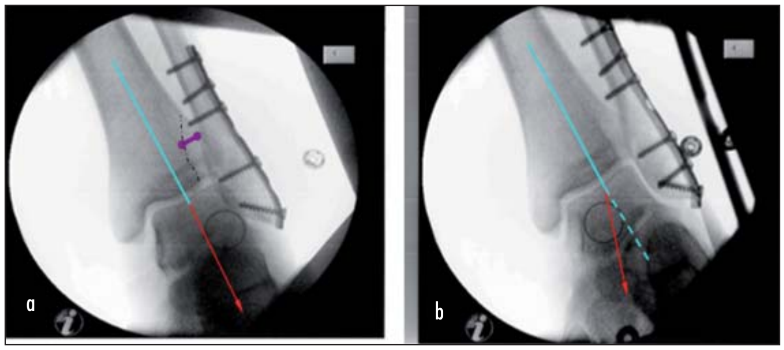


Figure 4. Intraoperative assessment of the tibiofibular syndesmosis with (a) anteroposterior and (b) mortise radiographs. Note the direction of the foot (red arrow) is in neutral for the anteroposterior and in around 20° of internal rotation for the mortise view. An intact syndesmosis is confirmed when the distance (purple line) between the incisura of the tibia (dashed line) and the medial cortex of the fibula is less than 5 mm at a point 1 cm above the joint and when there is at least 1 mm of tibiofibular overlap on the mortise view. From Harper and Keller (1989).

Arthroscopy remains the gold standard in the diagnosis of a distal tibiofibular syndesmotic disruption and can detect injuries that have been missed on static and stress radiography (Lui et al, 2005). However, use of arthroscopy is confined to evaluation of chronic injuries and its use in the acute setting is not commonplace. Arthroscopically, the stability can be assessed in the coronal, sagittal and the axial planes and associated injuries can also be identified and treated. *Table 2* lists some of the injuries that can accompany ankle sprains, some of which can be identified and treated arthroscopically. If these injuries are overlooked at presentation they can result in chronic ankle pain after sprains.

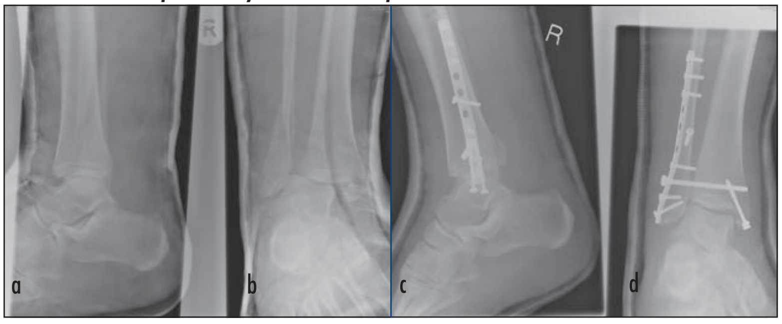
Table 2. Injuries associated with ankle ligament injuries
Malleolar fractures
Anterolateral impingement, e.g. meniscoid lesion
Talar fractures
Osteochondral lesions of the talus
Sinus tarsi syndrome
Peroneal tendon subluxation or injury
Posteromedial impingement syndrome
Tibialis posterior injury

Management

Ankle ligament injuries associated with a fracture may require internal fixation and are outside the remit of this review. The management of ligament injuries in the absence of a fracture is discussed below.

- Prevention of ankle sprains in high-risk sporting activities is recommended. A Cochrane review (Handoll et al, 2001) has suggested that there is good evidence for the beneficial effect of ankle supports in the form of semi-rigid orthoses or air-cast braces to prevent ankle sprains during high-risk sporting activities and in particular field sports such as football. This should be especially considered in individuals with a history of ankle instability to prevent the risk of recurrent injury.
- Isolated medial ligament injuries in the absence of a fibular fracture are rare but can result in significant morbidity. It has been suggested that in the presence of medial instability surgical repair and reattachment followed by a period of immobilization is the treatment of choice (Hintermann, 2003).
- Syndesmotic disruption that results in tibiofibular diastasis is treated surgically. The traditional technique is the insertion of a cortical bone screw across the mortise to 'close' the diastasis and splint the injured ligaments until healing is complete (Kaye, 1989). More recently, flexible suture-button syndesmosis fixation has become popular (Seitz et al, 1991). This has been shown to have shorter rehabilitation times (Thornes et al, 2005) and avoid the need for implant removal before commencement of weight bearing. *Figure 5* demonstrates a syndesmotic disruption before and after reduction and internal fixation.
  Injuries to the syndesmosis in the absence of a diastasis are treated with immobilization and a graduated return to activity. Serial radiographs must be obtained to detect any delayed diastasis.
- Stretch or partial rupture of lateral ligaments in the absence of instability is treated conservatively with rest, ice, compression and elevation. A short period of splinting and initial protected weight bearing with crutches may be appropriate depending on the degree of pain and functional loss; however, early introduction of physiotherapy and functional therapy has been shown to improve outcome (Kerkhoffs et al, 2002a) and should therefore be encouraged.
- Treatment of significant disruptions of the anterior and middle components of the lateral complex is more controversial. In the acute setting some may advocate direct repair in the elite athlete. A Cochrane review has suggested that there was 'insufficient evidence' to determine the relative effectiveness of surgical and conservative treatment in this setting (Kerkhoffs et al, 2002b). The same review suggested that there was a significantly higher incidence of objective ankle instability in those treated conservatively but with a lower incidence of ankle stiffness, complications and an earlier return to employment. In fact when these injuries are treated conservatively, in the general population, only 15–20% develop chronic instability requiring specialist intervention.

Figure 5. a and b. Radiographs demonstrating a supination and external rotation type IV ankle fracture treated with internal fixation. c and d. A 4.5 mm diasthasis screw has been used to treat and splint the syndesmotic disruption.



The surgical options when treating these injuries in the chronic setting fall into two broad groups: anatomical repair or non-anatomical reconstruction.

There are various techniques described which have been reviewed (de Vries et al, 2006). This review did not support any one procedure over the others. The anatomical procedures such as the Brostrom procedure aim to reconstruct the anterior talofibular ligament and tighten the damaged structures. The Gould modification of this procedure uses the extensor retinaculum to reinforce the repair. Here the anterior talofibular ligament and calcaneofibular ligament are explored and the rupture ends freshened. A capsulotomy is performed at the anterior margin of the fibula leaving a cuff of tissue for later repair. The ligaments are then attached to the distal fibula either through drill holes or by using anchor sutures. The posterior edge of the retinaculum is then advanced and secured to the anterior edge of the fibula using the cuff of capsule described above. These are relatively small procedures with less morbidity but associated with a greater degree of talar tilt when compared to non-anatomical reconstructions.

The Chrisman–Snook procedure (*Figure 6*) is an example of the latter where a split peroneus brevis tendon graft kept attached to its insertion on the base of the fifth metatarsal is rotated and tunnelled through the distal fibula and the os calcis, thus aiming to reconstruct both the anterior talofibular ligament and the calcaneofibular ligament. It should be noted that there are numerous techniques described using a variety of autologous or analogous grafts.

The authors agree with Baumhauer and O'Brien (2002) who suggested that a modified Brostrom lateral-ligament repair is probably the first choice for persistent ankle instability refractory to a functional ankle rehabilitation protocol. Non-anatomical reconstructions should be reserved for patients with generalized ligament laxity or long-standing ligament insufficiency or as a salvage procedure in patients with a failed modified Brostrom lateral-ligament repair.

Conclusions

Ankle sprains in the absence of fractures most commonly affect the lateral ligaments. There is insufficient evidence to suggest an acute repair is required. The majority of individuals can be treated with an active rehabilitation programme. A long period of immobilization has been shown to delay return to activity in ankle sprains. Those refractory to rehabilitation programmes and with chronic instability should be considered for an anatomical repair such as the Brostrom procedure.

Isolated injuries to the medial and syndesmotic ligaments are rare. However, when in combination with other bony or soft tissue injuries they commonly result in instability and surgical treatment is advocated. **BJHM**

Conflict of interest: none.

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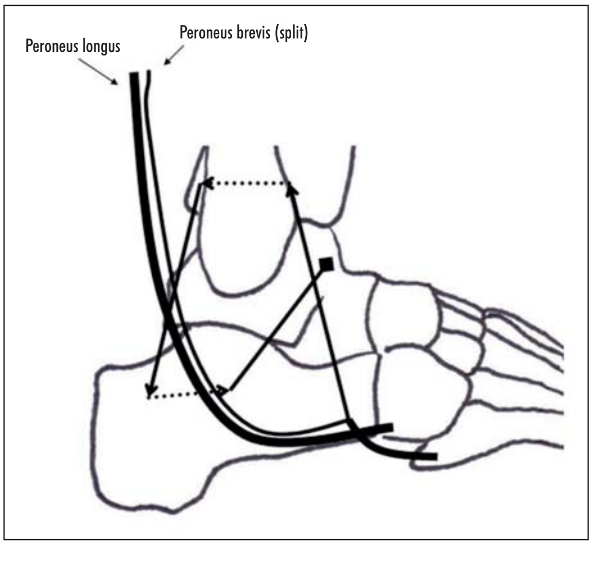
Figure 6. Ankle ligament reconstruction. Dashed lines represent passage of the tendon graft through tunnels in the corresponding bones.



KEY POINTS

- Injuries to the anterior talofibular ligament alone or in combination with a calcaneofibular ligament injury comprise 85% of all ankle sprains.
- Clinical examination in addition to careful assessment of the radiographs is essential in determining the nature of the injury.
- In the presence of fractures, careful assessment using the Lauge-Hansen classification can help predict the injured structures and guide management.
- Persistent ankle instability should be treated surgically with a direct repair (anatomical) procedure.
- Non-anatomical reconstructions are used as a salvage procedure or in those with general ligament laxity.