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Management of syndesmotic injuries of the ankle

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- Injuries to the tibioperoneal syndesmosis are more frequent than previously thought and their treatment is essential for the stability of the ankle mortise.
- Recognition of these lesions is essential to avoid long-term morbidity.
- Diagnosis often requires complete history, physical examination, weight-bearing radiographs and MRI.
- Treatment-oriented classification is mandatory.
- It is recommended that acute stable injuries are treated conservatively and unstable injuries surgically by syndesmotic screw fixation, suture-button dynamic fixation or direct repair of the anterior inferior tibiofibular ligament.
- Subacute injuries may require ligamentoplasty and chronic lesions are best treated by syndesmotic fusion.
- However, knowledge about syndesmotic injuries is still limited as recommendations for surgical treatment are only based on level IV and V evidence.

Keywords: syndesmosis injury; ankle; ligaments; diagnosis; imaging; management; operative technique

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Introduction

The term syndesmotic injury is used to describe a lesion of the ligaments that connect the distal fibula and the tibial notch surrounded on both sides by the anterior and posterior tibial tubercles, with or without an associated injury of the deltoid ligament. It includes four major ligaments: the anterior inferior tibiofibular ligament (AITFL), which limits the fibular external rotation; the interosseous ligament (IOL), which limits the lateral translation of the fibula; the posterior inferior tibiofibular ligament (PITFL), which prevents the posterior fibular translation; and the inferior transverse ligament, which limits posterior talar displacement (Fig. 1).[1] On the other hand, the deltoid ligament has the function of preventing talar abduction, pronation and external rotation. Syndesmotic lesions with associated damage of the deltoid ligament produce a still greater instability of the talus.[2] This instability, if uncorrected, can lead to chronic instability that can finally develop into degenerative arthritis.[3]

The first case of syndesmotic injury was described by Quenu in 1907[4] as a tibioperoneal diastasis after a ligamentous disruption and thereafter began to be studied in more depth. It has been classically described as being much less common than those of the lateral ligament, representing 1% to 18% of ligamentous lesions of the ankle.[5,6] However, recent studies show that its incidence is much higher, in the range of 17% to 74% of all sports injuries of the ankle, due in part to the improvement in the diagnosis and understanding of the mechanisms of production of these lesions.[7,8] On the other hand, it is still difficult to understand completely how these injuries actually occur, and as a consequence, their treatment remains controversial in many cases.[9]

This article aims to review what we currently know about the clinical-radiological diagnosis, classification and management of these complex injuries.

Clinical presentation

It is very common to consider syndesmotic injuries rather simplistically, employing a physiotherapeutic treatment without having a true and complete evaluation. As in most injuries, careful history-taking and physical examination are very important to arrive at a correct diagnosis and therefore an effective treatment.

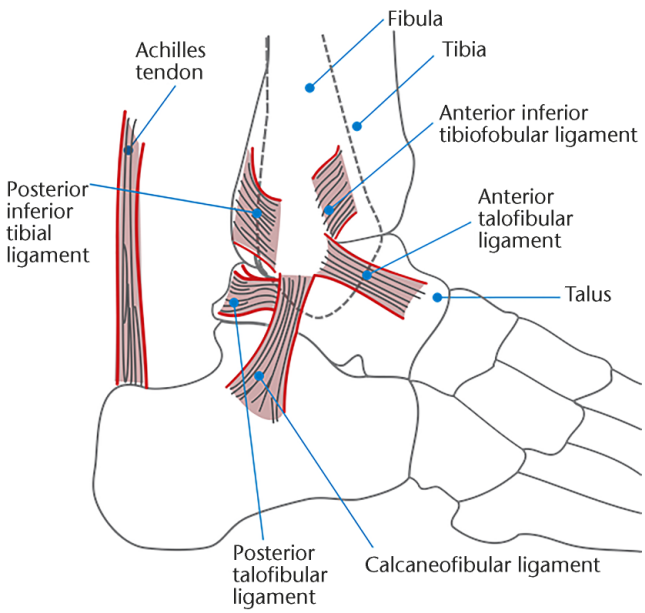

Fig. 1 Drawing showing the ligaments of the lateral side of the ankle. Reproduced with permission.[1]

Severe oedema is not usually present in this injury at the time of examination, as opposed to ankle sprains where it is more frequent. This should make us suspicious, especially with increasing pain felt with external rotation or forced dorsiflexion of the ankle. An antalgic heel-raised gait pattern and tenderness with palpation of the AITFL is usually present.[10] In more severe cases, this lesion may be associated with a deltoid or anterior talo-fibular ligament injury.[11]

The difficulty that sometimes exists in detecting this injury has led to the development of numerous clinical examination tests, including the 'external rotation' test, the 'Cotton' test, the 'fibular-translation' test, the 'squeeze' test and the 'crossed-leg' test.[12] These tests may be applicable to both acute and chronic lesions.

The European Society of Sports Traumatology, Knee Surgery and Arthroscopy-Ankle & Foot Associates (ESSKA-AFAS) consensus panel[2] recommends that clinical tests include: tenderness on palpation over the AITFL and PITFL, the more proximal the pain, the greater the extent of the lesion; the 'fibular translation' test; and the 'Cotton' test.

The 'fibular translation' test is performed by drawing the fibula forward and backward with the tibia stabilised, while the 'Cotton' test is performed while attempting translation of the talus from side-to-side with the ankle in a neutral position; increased translation as compared with the contralateral side accompanied by pain, make these tests positive (Figs 2 and 3).[12,13] The 'external rotation' test, 'squeeze' test and 'crossed-leg' tests are excluded from the consensus as they have a low positive predictive value and poor intra-examiner reliability.[14] Despite this, efforts must be made to undertake level I and II diagnostic accuracy studies to determine the specificity, sensitivity, positive and negative likelihood ratios.[2]

Fig. 2 'Fibular translation' test. The fibula is translated from anterior to posterior on the tibia. The test is positive when increased anteroposterior movement is felt compared with the opposite ankle.

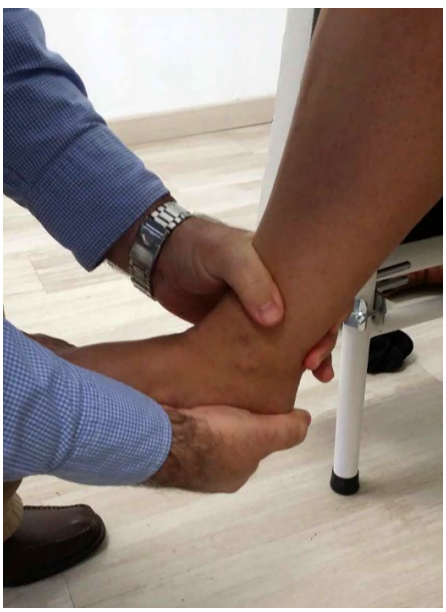

Fig. 3 'Cotton' test. Medial and lateral forces are applied to the talus with the ankle in the neutral position. The test is positive when increased mediolateral movement is felt compared with the opposite ankle.

Imaging

Diagnostic imaging is mainly based on simple radiograph and MRI for both acute and chronic lesions. Appropriate imaging to assess changes in mortise alignment and affected ligaments are mandatory to optimise treatment.

Radiographic imaging should include three views of the ankle: anteroposterior (AP); mortise; and lateral. A mortise view taken with the patient positioned in unilateral weight-bearing is the most accurate way to assess

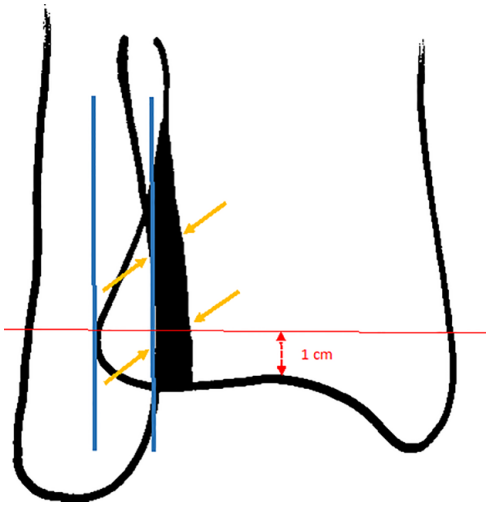

Fig. 4 Radiographic measurements of the ankle in the anteroposterior view at 1 cm above tibial plafond. Depicted tibiofibular clear space (orange arrows) and tibiofibular overlap (blue lines).

displacement, but not all patients will tolerate this position immediately following the injury due to pain. Bilateral weight-bearing or non-weight-bearing radiographs can be considered instead. Radiographic evaluation with full-length AP and lateral views of the leg should be performed to rule out a Maisonneuve fracture[2,12] on plain radiographs. These include increased tibiofibular clear space and decreased tibiofibular overlap. The first parameter is represented by the space between the medial border of the fibula and the lateral border of the posterior tibial prominence. This distance in both AP and mortise views should be < 6 mm with an intact syndesmosis. The other parameter is the maximal overlap between the medial border of the fibula and the lateral border of the distal tibia. Normal tibiofibular overlap for the AP view is > 6 mm. Normal tibiofibular overlap for the mortise view should be > 1 mm. Both parameters should be measured 1 cm above the tibial plafond (Fig. 4).[2,11]

Nevertheless, it has been estimated that plain radiographs have 44% to 58% specificity only, so a radiographic diagnosis based solely on these tests would result in a high number of false positives.[15,16] Therefore, in cases of doubt, a CT scan is recommended to precisely assess the position of the fibula in the incisura. It is more sensitive than plain radiography in detecting syndesmotic injuries based on diastasis.[12] Ultrasonography is also not recommended because of low reliability and its dependence on the investigator.[2]

MRI has a near-100% specificity in all cases of syndesmotic injury with high inter-observer agreement.[17] MRI displays the structures of the syndesmosis and allows for the grading of ligamentous injuries (Table 1).[12]

MRI is useful for diagnosing tibiofibular syndesmotic disruption because it enables good visualisation of the AITFL and the PITFL and is not invasive. Furthermore, MRI is able to clearly define the lesion and associated injuries and can be useful in determining prognosis following a syndesmosis sprain.[2]

Classification

Recently, Van Dijk et al,[2] in their ESSKA-AFAS consensus panel, thoroughly revised the classifications most used by the different authors to date.

They classify syndesmotic injuries depending on the time elapsed since trauma as acute (less than six weeks), subacute (between six weeks and six months) and chronic (more than six months), as management will be different regarding the time frame.[2]

Acute injuries can be categorised into stable and unstable. Stable sprains are characterised by a lesion of the AITFL, with or without IOL, with an intact deltoid ligament. Unstable sprains also include lesions of the deltoid ligament and can be divided into latent and frank. Latent diastasis compromises AITFL lesion with or without IOL and the deltoid ligament lesion, and frank diastasis lesion of all syndesmotic ligaments and the deltoid ligament (Fig. 5).[2]

Finally, subacute injuries can be further subdivided into repairable or non-repairable depending on the presence or absence of adequate remnants of AITFL, and chronic can be further subdivided based on its association or not with arthritic ankle changes (Fig. 6).[12]

Management

Acute injuries: conservative treatment

Syndesmotic sprains without instability should be treated non-operatively as they usually heal after conservative management.[18]

Table 1. Grading of syndesmotic injuries according to MRI findings

Grade	MRI findings	Pathologic lesion
I	Oedema adjacent to an intact ligament	Stretching of the ligament without fibre disruption
II	Thickening of the ligament with partial fibre disruption and associated oedema	Partial tearing of the ligament
III	Discontinuity of the ligament and extensive oedema	Complete tear of the ligament

Fig. 5 Lateral radiograph showing dislocation of the ankle with complete injury of all syndesmotic ligaments and deltoid ligament.

The most widespread protocol is the three-phase approach. The first phase of the treatment includes rest, ice, compression and elevation for a period of one to two weeks along with non-weight-bearing immobilisation, preferably in a controlled ankle movement walker boot, so as to avoid stiffness. In the second phase, walking in a functional brace can be started, together with physiotherapy including joint mobilisation, strength training and restoration of basic ankle functions. The final phase includes the training of neuromuscular control and proprioception until complete recovery.[10,15] Stable injuries have a very good outcome. Amendola et al[18] reported that most patients return to good or excellent function once their injury recovered, although they should be monitored for a minimum of six months to rule out complications such as heterotopic ossification, syndesmotic calcification or anterior impingement syndrome secondary to fibrous scar formation.[13] The average time to return to normal activities is between four and eight weeks.[3]

Acute injuries: surgical treatment

Any acute syndesmotic ligament rupture with frank or latent instability of the ankle should be managed operatively.[2] The goals of surgery are reduction and maintenance of the structures in their correct position so that the ligaments can heal properly.[12] This is achieved by syndesmotic screw fixation, suture-button dynamic fixation or repair of the AITFL with direct sutures, suture anchors or screws with washers.[9]

Screw fixation is probably the most frequently used technique to treat these lesions. They can be inserted percutaneously with the ankle in neutral position, once a good indirect reduction is obtained with a tibiofibular clamp (Fig. 7).

Quadricortical fixation with two 4.5-mm screws is preferred, as this technique is more rigid, with less occurrence of syndesmotic widening during healing, and easier removal if screw failure occurs.[19] It has been proven that two screws offer greater resistance than a single one and also that screws of 4.5 mm are more resistant than those of 3.5 mm.[20] Larger screws or more than two screws are not advised because screws > 4.5 mm may induce fibular fracture.[21] The screws should be placed 2 cm or 3 cm above the joint line to avoid further injury to the ligaments and angled 20° to 30° anteromedially, as recommended by some authors.[22,23] Full weight-bearing is not recommended for at least two months, until the screws are removed, to avoid breakage or damage to the ankle joint.[11,24,25] Some authors recommend usage of one or two trans-syndesmosis screws incorporated with a one-third tubular plate to obtain a more consistent structure (Figs 8 and 9).[3] There is no definitive evidence for the need for screw removal after syndesmotic fixation.[26,27]

To avoid problems associated with screws, in particular the long time required non-weight-bearing, suture-button fixation appeared to be a good alternative. It is sufficient to stabilise the syndesmosis during healing, allowing for

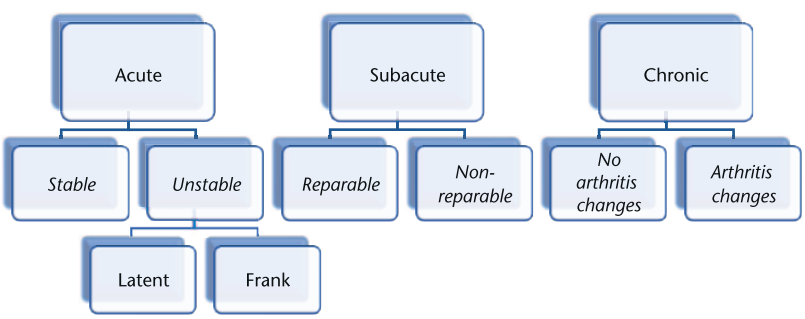

Fig. 6 Classification of syndesmotic injuries of the ankle.

Fig. 7 Tibiofibular clamp placed before proceeding to screw fixation.

Fig. 8 One-third tubular plate with two tri-cortical screws to treat a Maisonneuve fracture, pre- and post-operatively.

some physiological movement,[28-31] although biomechanical studies have proved that a suture button provides less syndesmotic reduction than screws.[32] Therefore, it is advisable to tension the system with the ankle partially in plantar-flexion, allowing for an even tighter closure of the mortise (Figs 10 and 11). The position of the implants is the same as the position of the screws (Fig. 12). The correct position of fixation is the most relevant prognostic parameter either using screws or suture-button implants.[33] Progressive full weight-bearing as tolerated is allowed after two to three weeks. In the meantime, the patient should wear a walker boot and practise only slight weight-bearing.

Subacute and chronic injuries

It is considered that non-acute lesions do not resolve with conservative treatment alone and often require surgical treatment.[34]

Fig. 9 Pre- and post-operative radiographs of the procedure mentioned in Figure 8.

Fig. 10 Operative photograph showing plantarflexion of the ankle before tensioning the implant.

In subacute (six weeks to six months) injuries, the goal is repair or reconstruction of the syndesmosis and protection with screw fixation. The AITFL should preferably be sutured with or without anchors. Non-repairable ligament should be replaced by a ligamentoplasty to restore normal function of the distal tibiofibular joint. An autologous peroneus brevis or longus tendon may be used, although there are only a few papers in the literature which mention it.[9,35]

In chronic (more than six months) injuries, a syndesmotic fusion is recommended although the level of evidence for surgical treatment in this situation is very low (levels IV and V). The technique usually implies the use of a rotated bone plug also fixed with screws. It is noted by

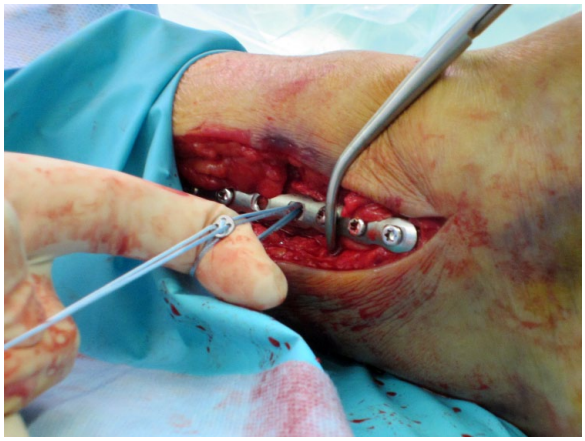

Fig. 11 Operative photograph showing tensioning of the implant.

several surgeons that this procedure normally produces no limitation of dorsiflexion nor sustained discomfort and is a good alternative in these cases of long duration where no other options are available.[36-39]

The post-operative period after these techniques will require protected non-weight-bearing for at least six weeks. Screws can be removed from eight weeks to 12 weeks post-operatively. Thereafter, progressive weight-bearing can be started along with an exercise programme.[35]

Previous ankle osteoarthritis is a predictor of poor outcome of these techniques, so tibiotalar arthrodesis is then preferred.[35,40]

Lesions of the ankle syndesmosis may lead to significant disability and time loss. Early recognition and appropriate treatment are the keys to restore stability, mobility and strength, with the aim of regaining the pre-injury function of the ankle. Otherwise chronic pain, prolonged recovery, recurrent sprains, heterotopic ossification, ankle instability and, finally, osteoarthritis are likely. Unfortunately, these lesions are difficult to diagnose and improving outcomes from these complex injuries requires awareness of mechanism of injury, a detailed physical examination, including the 'fibular translation' test and the 'Cotton' test among others, and appropriate imaging using least high-quality plain radiographs, MRI or CT scans.

Acute instability of the syndesmosis must be treated surgically by placing a syndesmotic screw or a suture button. Sometimes AITFL repair is all that is needed. Subacute (six weeks to six months) injuries are best treated by ligament repair and temporary syndesmotic screw fixation or, in cases of severely damaged ligaments, ligamentoplasty. Chronic (more than six months) injuries should be treated by distal tibiofibular rotated bone-plug fusion. In cases of ankle osteoarthritic changes, ankle fusion should be considered.

Outcomes obtained in recent studies on each technique are encouraging, but it must be stated that these

Fig. 12 Anteroposterior radiograph showing an example of plate fixation combined with dynamic suture button.

treatment options are still based on level IV and V evidence. There is a need for better guidelines for the diagnosis and classification of these lesions together with more extensive prospective studies comparing different surgical procedures to better understand these lesions and correctly guide the best treatment individually.

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