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OTSR-102778; No. of Pages 11
ARTICLE IN PRESS
Orthopaedics & Traumatology: Surgery & Research xxx (xxxx) xxx
Contents lists available at ScienceDirect
Orthopaedics & Traumatology: Surgery & Research
journal homepage: www.elsevier.com

Review article / Adult traumatology

Traumatic injuries of the distal tibiofibular syndesmosis

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ARTICLE INFO

Article history:
Received 30 October 2019
Accepted 15 May 2020
Available online xxx

Keywords:
Syndesmosis
Ankle injury
Instability

ABSTRACT

Aim: The distal tibiofibular syndesmosis (DTFS) is frequently injured during ankle trauma. The sequelae can be significant, including chronic instability, early osteoarthritis and residual pain. The aim of this study is to summarize the current state knowledge about these injuries by answering four questions.
How common are syndesmosis injuries?: They frequently occur in the context of an ankle sprain (20–40% of cases) or during various types of ankle fractures (20–100% of cases). They cannot be ruled out based solely on fracture type and must be investigated when a fibular or posterior malleolar fracture is present.
How are they diagnosed?: Clinical examination and imaging are essential but do not provide a definitive diagnosis. Ultrasonography, CT scan and MRI have high sensitivity, but their static nature does not allow a treatment strategy to be defined. Dynamic radiographs must be taken, either with load or during a procedure. If instability is detected, stabilization is the general rule.
How is the syndesmosis reduced and stabilized?: In fracture cases, reduction is achieved by restoring the length and rotation of the distal fibular fragment, preferably during an open procedure. In sprain cases, reduction is not a problem unless there is ligament interposition. Tibiofibular fixation is done 1.5 to 3 cm from the talocrural joint, while ensuring the reduction is perfect.
What outcomes can be expected?: The main complication–non-healing of the syndesmosis–is attributed to poor initial reduction. This or functional discomfort during weight bearing will require removal of the fixation hardware. In most cases, this allows functional recovery and correction of the inadequate reduction. Persistence of instability will require ligament reconstruction or fusion of the syndesmosis. Chronic instability can lead to ankle osteoarthritis.
Level of evidence: V, expert opinion.

1. Introduction

The distal tibiofibular joint, or distal tibiofibular syndesmosis (DTFS), has a highly variable tibial "articular" surface. In 60–75% of patients, the tibial surface is concave while in the others, it is convex or irregular [1,2]. The ligament complex consists of the anterior inferior tibiofibular ligament (AITFL), the posterior inferior tibiofibular ligament (PITFL), the transverse tibiofibular ligament (TTFL) and the interosseous membrane (IOM) [1–3] (Fig. 1).

The primary mechanism of injury for the DTFS is external rotation combined with ankle dorsiflexion [1]. During these movements, the wider, anterolateral portion of the talar dome pushes the fibula which spreads away from the tibia until the syndesmosis is damaged, if the force is large enough.

Surgical treatment aims to reduce the risk of chronic instability and early osteoarthritis in the talocrural joint. The aim of this study is to summarize the current state knowledge about these injuries by answering four questions:

- how common are syndesmosis injuries?;
- how are they diagnosed?;
- how is the syndesmosis reduced and stabilized?;
- what results can be expected?

2. How common are syndesmosis injuries?

Ankle injuries cause 20 to 45% of all syndesmosis lesions [1]. These injuries can either be ankle sprains or ankle fractures. For ankle sprains, a syndesmosis lesion is found in 40% of grade I sprains, 40% of grade II sprains and 20% of grade III sprains [4].

As for fractures, it is accepted that all Weber C fibular fractures are associated with a syndesmosis tear unlike Weber A fractures [5]. The most controversial combination is in Weber B fractures, which are associated with 17% to 39% syndesmosis tears [6]. The equivalent in the Lauge–Hansen classification [7] is a supination – external rotation fracture in which DTFS tear is considered rare, while it is

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https://doi.org/10.1016/j.otsr.2020.102778
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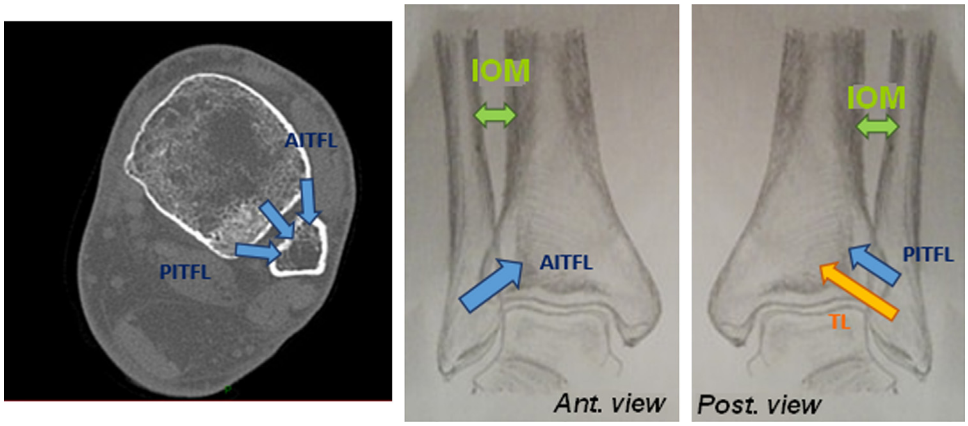

Fig. 1. Ligament structures contributing to distal tibiofibular syndesmosis stability. Note the more lateral position of the anteroinferior tibiofibular ligament (AITFL), which is more exposed than the posteroinferior tibiofibular ligament (PITFL). IOM: interosseous membrane; TL: talus.

present in more than 40% of cases during dynamic testing [8]. The height of the fibular fracture has a positive predictive value for DTFS tear when it is located 5 cm above the talocrural joint [9,10].

When the posterior malleolus is fractured, one must consider the possibility of a syndesmosis lesion. Since the PITFL inserts on the posterior tubercle of this malleolus, syndesmosis stability is compromised when the entire malleolus or isolated tubercle is fractured, although the reduction of a large posterior bone fragment helps to recover this stability if the PITFL is intact [10].

In summary:

- the syndesmosis can be damaged during an ankle sprain or fracture; this damage cannot be ruled out solely based on fracture classifications;
- one must always look for a syndesmosis injury in the context of a fibular facture, even a Weber B type, but also in the presence of a posterior malleolus fracture, since there is a high incidence of associated syndesmosis tears;
- a syndesmosis tear is a sign of severity, as it negatively affects the prognosis of ankle injury, whether a fracture or sprain with isolated syndesmosis tear.

3. How are they diagnosed?

The diagnosis of a syndesmosis tear is challenging. It requires an extensive clinical examination along with imaging assessments.

3.1. Clinical examination

When an ankle fracture is present, the clinical tests described below cannot be done. They are only valid for syndesmotic sprains and in chronic forms. The clinical examination consists of inspection and palpation of the bone and ligaments around the talocrural and knee joints (Fig. 2) [11]. The deltoid ligament may be sensitive to pressure; a depression in this area suggests that it may be torn. The bundles of the lateral collateral ligament may also be painful when pressure is applied. Various tests specific to DTFS lesions have been described: dorsiflexion external rotation stress test (Kleiger's Test), squeeze test, crossed leg test, Cotton test and the fibula translation test (Fig. 3) [1]. When positive, they are suggestive of at least a grade 2 sprain in the Clanton classification (Fig. 4). The first two tests are highly specific (85% and 94%, respectively) although their sensitivity is low (20% and 30%, respectively) [4]. Thus, lesions are often missed if only these tests are used.

3.2. Additional examinations

3.2.1. Conventional radiography

Along with looking for an ankle fracture, conventional radiography is used to look for syndesmosis tears, especially in chronic forms and after ankle sprains.

Harper and Keller defined the normal parameters for the ankle (Fig. 5) [12,13]:

- a tibiofibular clear space (TCS) – measured between the medial cortex of the fibula and the anterior lateral cortex of the ankle mortice – of less than 6 mm on an AP view and mortise view;
- tibiofibular overlap (TFO) – measured between the medial cortex of the fibula and the most lateral edge of the ankle mortise at the level of the syndesmosis – of more than 6 mm or 42% of the fibular width on an AP view;
- TFO > 1 mm on a mortise view (AP view with 20° internal rotation of leg).

Values outside these norms are suggestive of an injury. However, in some patients, the TFO is less than 1 mm while in others, it is much larger than 6 mm [14]. Since not having TFO may be a normal physiological variation, it cannot be used to confirm the diagnosis of DFTS injury. The TCS appears to be the most reliable diagnostic criteria as it is relatively independent of ankle rotation (3.9 ± 0.9 mm; 2–5.5 mm) [13]. In case of doubt, the radiographs must be compared to that of the contralateral ankle.

An AP view of the lower leg must be also made when the patient has pain upon palpation of the proximal tibiofibular joint to rule out dislocation of this joint or Maisonneuve fracture [1].

Except for patients with ankle dislocation or suspicion of displaced fracture, radiographs should be done with the patient standing, since unloading can hide a syndesmosis tear (Fig. 6). Thus, a normal conventional radiograph is not sufficient to rule out a serious injury. Despite a 100% specificity, its sensitivity is only 58% [15].

Stress radiography is not possible if there is a complex or displaced ankle fracture or the ankle is dislocated. In other cases, it can be used to assess the syndesmosis by using a forced valgus movement or ankle dorsiflexion with external rotation of the foot. It is positive when diastasis appears and if a difference with non-stress radiographs of 2 mm is visible for the TCS and medial clear space (MCS) [1]. Since it may be difficult for the patient to relax fully, stress can be placed on the syndesmosis using gravity alone, which is less painful (Fig. 7) [16]. These dynamic tests are specific and very useful for making a diagnosis of syndesmosis instability in the

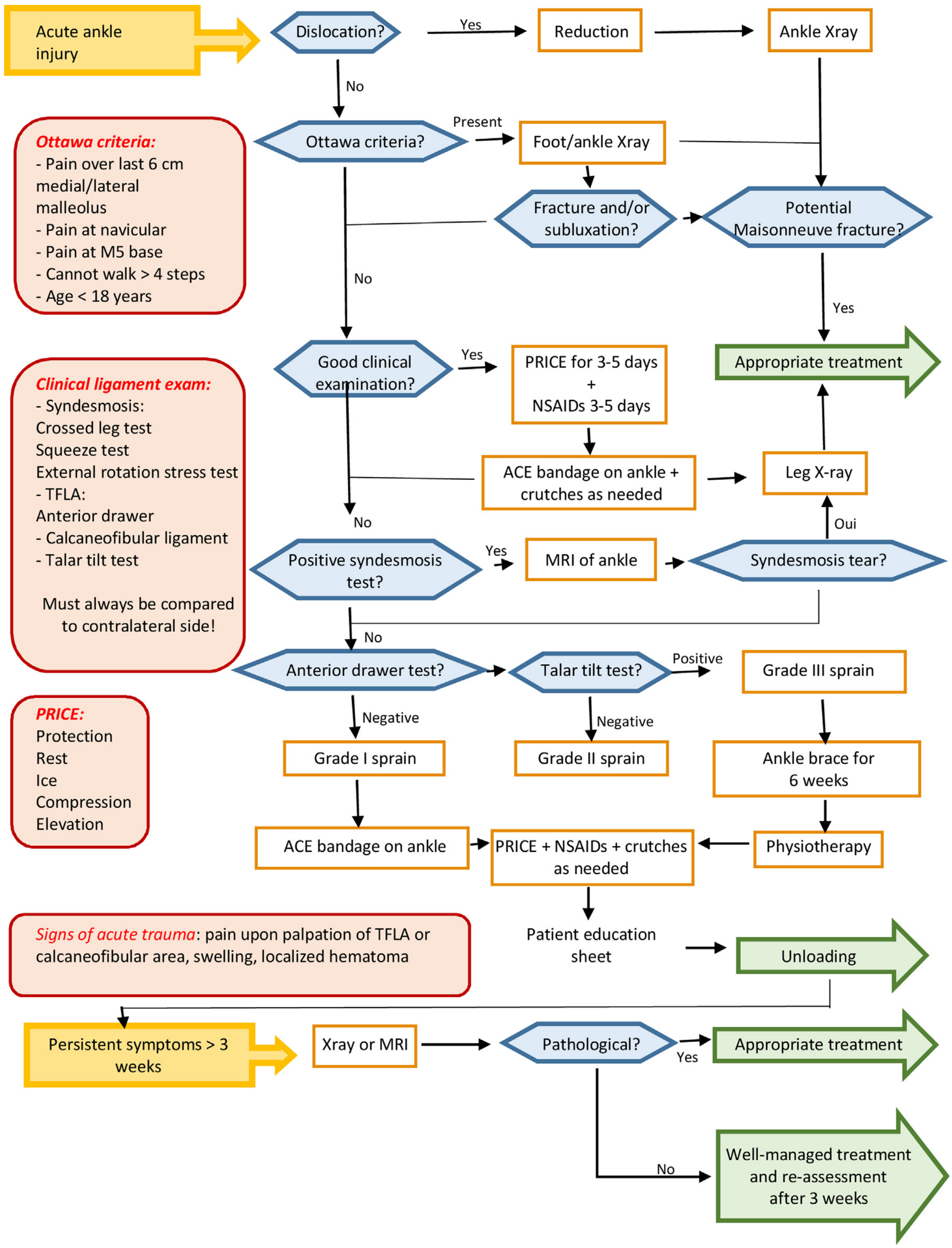

Fig. 2. Decision tree for the diagnosis and treatment of all ankle injuries [10]. NSAIDs: non-steroidal anti-inflammatory drugs).

context of an ankle sprain. However, some authors believe these are still not reliable enough [17].

3.2.2. Ultrasonography

Ultrasonography is an interesting option since its dynamic nature can show the continuity of the AITFL and the other ligaments in the ankle [18]. Ultrasonography is not very costly, is easily accessible and non-irradiating, although it requires expertise and is operator dependent.

3.2.3. CT scan and MRI

While CT scan and MRI are feasible, their static nature means they cannot predict instability during walking. They can also be done when there is a doubt about the DTFS in a patient with ankle fracture.

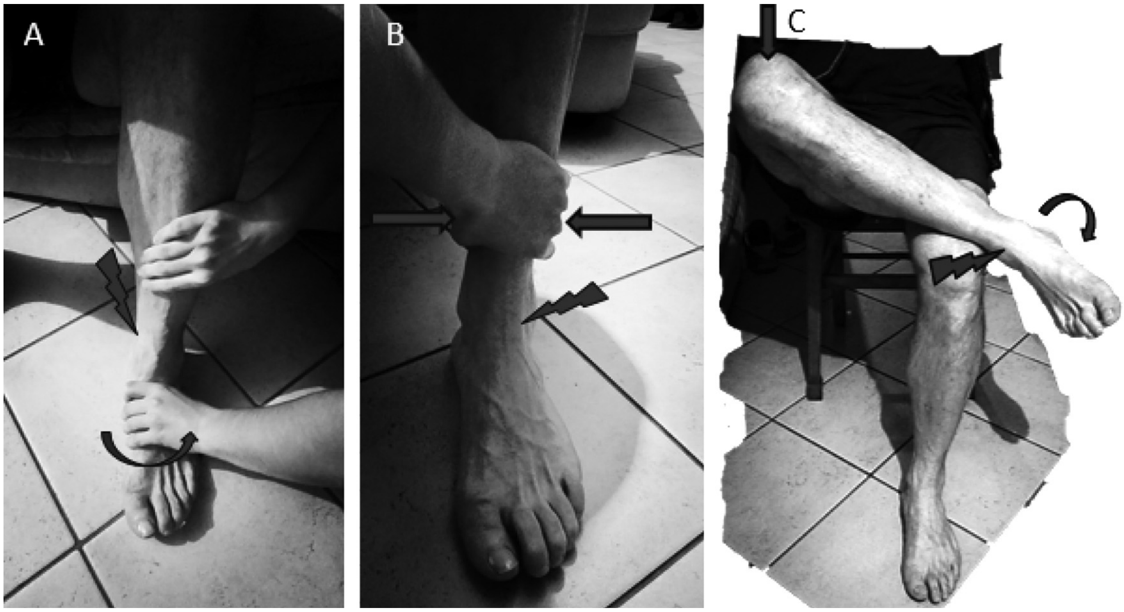

Fig. 3. Clinical tests. Kleiger (External Rotation) Test (A): anterolateral pain at the site of the anteroinferior tibiofibular ligament with pain reproduced in dorsiflexion and external rotation. Squeeze test (B): pain at the distal tibiofibular syndesmosis induced by compression of the tibia and fibular immediately above the ankle joint. Crossed leg test (C): with the lower leg placed on the contralateral knee, the ankle free, the foot's weight opens the distal tibiofibular syndesmosis when it is unstable. Cotton test: medial-lateral traction on the talus. Fibula translation test: anterior–posterior mobilization of the fibula.

Classification of syndesmosis injuries	
Grade I	Less severe Clinical: Pain upon palpation of AITFL Additional tests: Normal Xrays Injuries: Partial tear of AITFL -> Syndesmosis is stable
Grade II	Clinical: Positive external rotation and squeeze tests Additional tests: Normal Xrays Injuries: Complete tear of AITFL +/- other ligaments -> Syndesmosis may or may not be stable
Grade III	Severe injury Clinical: All clinical tests are positive Additional tests: Abnormal Xrays Injuries: Complete tear of AITFL + PITFL+ IOM + TL -> Syndesmosis is unstable

Fig. 4. Classification of syndesmosis injuries according to Clanton.

CT scan is better at detecting minor diastasis (< 3 mm), subluxation, presence of residual intra-articular bone fragments [1] and especially fibular rotation problems [19]. It is more sensitive than conventional radiography and has the benefit of providing an accurate assessment of reduction postoperatively [19]. Here again, variations from normal means the findings should be compared to the contralateral side.

MRI is sensitive and specific as it reveals bone marrow edema, which is proof of an AITFL tear (100% sensitivity, 93% specificity) and PITFL tear (100% sensitivity and specificity) [15], while providing an objective view of any ligaments injuries.

3.3. *Other diagnostic methods*

For sprains, arthroscopy provides a direct view during dynamic testing of the syndesmosis [15]. It is very useful when the radiographs are normal, while there are MRI signs or inconsistent radiological and clinical findings with a highly suggestive clinical examination but a negative MRI. Given its invasive nature, arthroscopy is only indicated in the most uncertain cases.

For fractures, the syndesmosis is always tested intraoperatively and must be re-evaluated after fixation [1]. The testing is done under fluoroscopy control while reproducing the injury

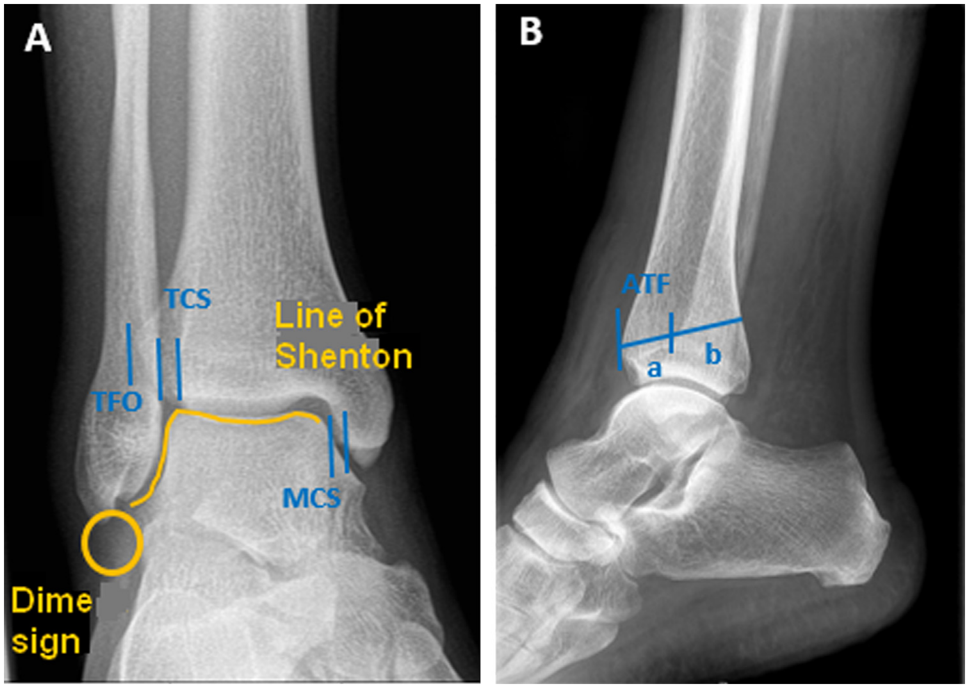

Fig. 5. Normal radiographic landmarks seen on a mortise AP view (15° internal rotation) (A) and lateral view (B). A: Mortise AP view; Shenton line: the two articular surfaces must be parallel; Dime sign: a circle can be traced between the tip of the lateral malleolus and the lateral side of the talus; Tibiofibular Clear Space (TCS): < 6 mm, measured between the medial part of the fibular cortex and the anterior lateral cortex of the ankle mortise; Tibiofibular Overlap (TFO): > 1 mm, measured between the medial cortex of the fibula and the most lateral edge of the ankle mortise at the level of the syndesmosis; Medial Clear Space (MCS): < 5 mm; B: lateral view; ATF: Anterior TibioFibular interval; AnteroPosterior TibioFibular (APTF) ratio = a/b (mean is typically 0.94).

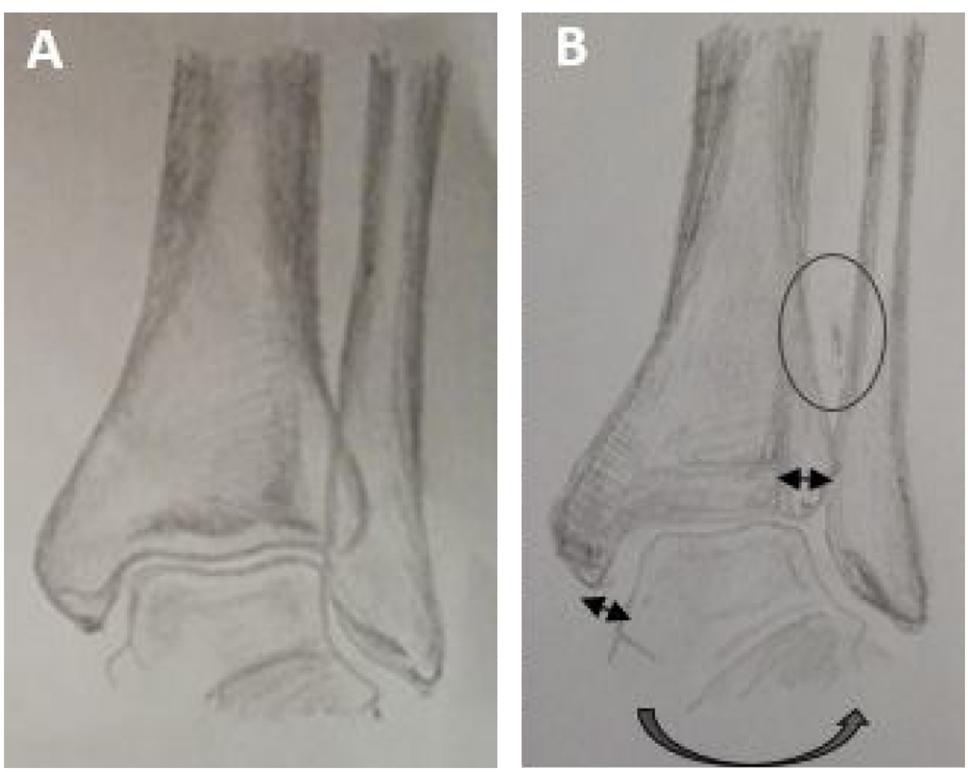

Fig. 6. Comparison of an unloaded ankle (A) and a loaded ankle in dorsiflexion and external rotation (B). A. Radiological criteria are met even though the syndesmosis may be injured. B. The MCS and TCS are wide with disappearance of the TFO. Possibility of syndesmosis calcification in chronic forms (black circle).

mechanism. The hook test is done with a hook or claw clamp by pulling laterally on the fibula. The syndesmosis must be repaired if this test reveals more than 2 mm diastasis [1]. Several authors have shown that the hook test is better than the forced external rotation test (7.5 Nm in principle) to detect instabilities [8,20]. The external rotation test may reveal widening of the medial clear space (MCS) if the deltoid ligament is torn but the syndesmosis is intact, while the hook test does not produce widening of the TCS since the

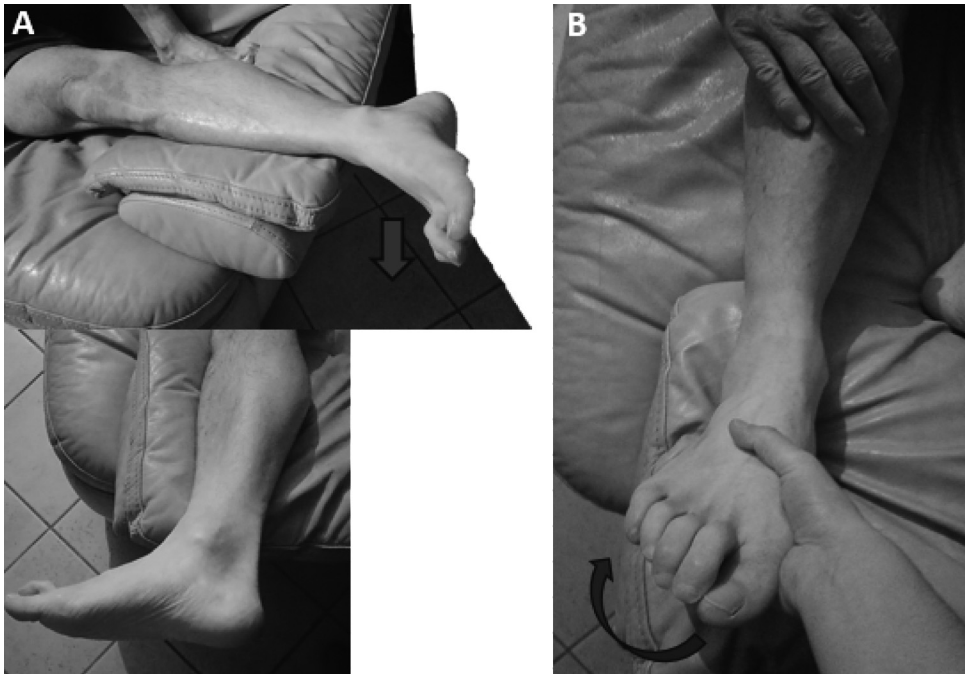

Fig. 7. Dynamic tests monitored with fluoroscopy: against weight bearing (A) or against manual load (B), which is longer and more irradiating.

syndesmosis is not torn [8]. Unfortunately, the sensitivity of both tests is poor [6,9].

In summary:

- for a sprain:
  - the clinical examination will consist of various specific tests for the syndesmosis, but this is not sufficient to detect all DTFS injuries,
  - additional examinations will be done in weight bearing (if possible) and/or dynamic testing to look for laxity that occurs during standing or walking;
- in the end, imaging has little value for the treatment decision compared to intraoperative discovery of instability. The risk of missing a DTFS tear is higher for sprain cases than for fracture cases undergoing surgery;
- CT scan can detect minor diastasis, rotational disorders and provides a comparison to the healthy contralateral side.

4. How is the syndesmosis reduced and stabilized?

The aim of surgery is to stabilize the joint. Restoring the congruence of the ankle mortise allows the various ligaments to heal in their anatomical position (both the ligaments of the ankle joint and those of the syndesmosis), thereby reducing the risk of chronic instability and secondary early osteoarthritis.

There is a consensus on the need to:

- repair the injury when the mortise is unstable;
- evaluate the reduction and stability of the syndesmosis repair using fluoroscopy.

Some elements of the treatment are still controversial [10]:

- which patients must be operated?;
- how should the injury be reduced?;
- which fixation method should be used?;
- which postoperative protocol should be applied and does the fixation screw need to be removed before weightbearing?

4.1. Which patients must be operated?

The surgical indication must be well though out since fixing the syndesmosis may limit ankle rotation during walking [6], with a risk of poor tibiofibular reduction estimated at 40% [2]. Stable and isolated syndesmosis injuries may benefit from conservative treatment (cast for 6 weeks without weight-bearing) [10]. But the need for surgical fixation has been questioned because there was little difference in pain, function, secondary osteoarthritis and morphological changes on MRI at 4–6 years of follow-up [21].

The surgeon must base the decision on the most objective criteria possible [1,10,22]:

- MCS difference greater than 2 mm from the heathy side or a “bimalleolar equivalent” fracture;
- presence of an associated lesion: fracture of distal fibula (4.5–5 cm above the distal articular line [9,19]) or proximal fibula, tear of deltoid ligament or posterior malleolar fracture;
- radiological confirmation of syndesmosis tear, obvious diastasis on dynamic tests or suspected on diagnostic arthroscopy.

4.2. How should the syndesmosis be reduced in fracture cases?

The variable anatomy of the DTFS can influence the displacement [1] although the fibula is nearly always displaced in shortening and external rotation. Conventional radiography cannot detect a rotation problem [1], and it underestimates the rate of poor reductions (24%) relative to CT scan (52%) [19]. A comparative CT scan is done if any doubt remains because there is very little inter-individual variation between sides [23]. Reduction of the DTFS must be anatomical [1]. It is vital to look for interposition of soft tissues or bone debris that would prevent syndesmosis closure at the level of the syndesmosis and MCS.

Rigid fixation with a screw has a risk of malleolar displacement and poor reduction (Fig. 8) [24]. Consequently, reduction of the fibula must be ensured first by longitudinal traction and internal rotation to achieve anatomical reduction before fixing the syndesmosis. The push-pull technique can be useful; a screw is

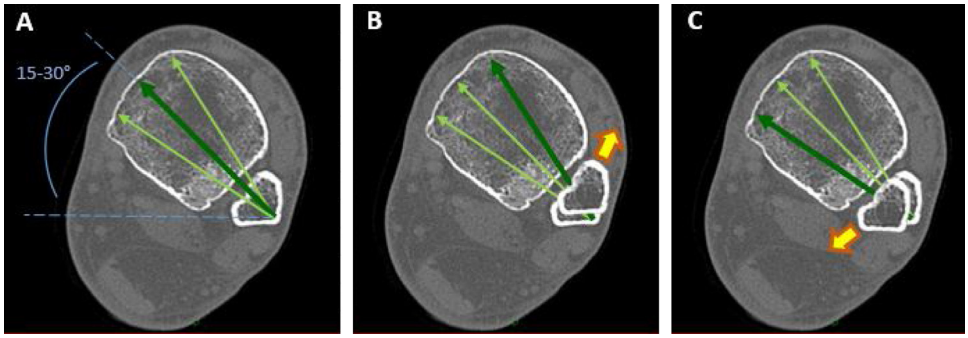

Fig. 8. Positioning of the syndesmosis screw and its impact on reduction. A. The aim is to have 15-30° anterior angle relative to axis of talocrural joint. B. If the screw is too far anterior, it shifts the distal fibula forward. C. If the screw is to far posterior, it shifts the distal fibula backwards.

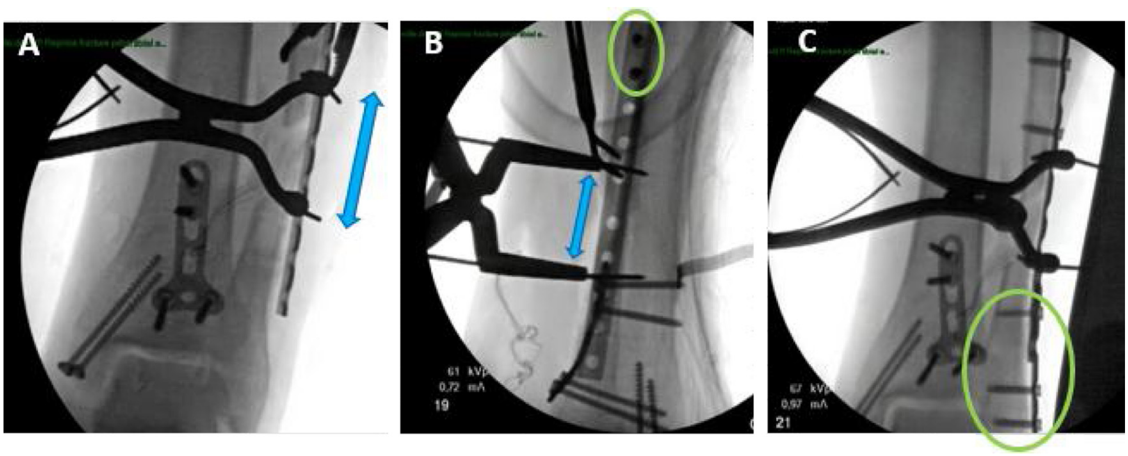

Fig. 9. Technique to reset the fibular length. A (AP view): insertion of two K-wires at the two ends of the fibula followed by distraction of the two fragments using a Hintermann retractor. B (lateral view): distraction can only be done if the proximal fibula is fixed beforehand, here by two proximal screws in the plate that act as a support point. C. Reduction acquired, and length restored; distal fixation can be done. In this case, a distal plate has been added to increase the fixation length.

introduced directly into the cortex from the outside, above the plate to help reset the length of the fibula by doing longitudinal distraction from between the screw and plate. This also makes it possible to correct rotational problems if the plate is positioned slightly to the back, because the distal fibular can reduce itself into internal rotation during the distraction. The same effect can be achieved with a Hintermann retractor (Fig. 9).

Surgical reduction of the syndesmosis can be done as a closed procedure, although the reduction criteria are based solely on fluoroscopy, with comparison to the other side being very important. Open reduction is preferable since we can do DTFS testing and have a direct view of the Mercedes sign, a three-branch star formed by the tibiotalar, talofibular and syndesmosis joints. It can be manual or not [1]. A clamp can be used before inserting the screw although its position must be checked carefully on mortise views. It must be positioned perfectly in the frontal and axial planes with both tips exactly against the cortex, without superimposition. During tightening, there is a risk of the fibula sliding in the sagittal plane and causing undesirable rotation of the distal fragment [1]. Excessive compression > 1 mm must be avoided as it has been observed in 44% of cases [24].

4.3. *Which fixation method and device should be used?*

4.3.1. *Screw*

The most used fixation device is a screw. It is placed parallel to the talocrural joint and oriented forward, with maximum angle of 15° to 30°. In fact, the fibula is located slightly behind the tibia (Fig. 10) [19].

Recent studies have shown that the ankle's position during fixation (dorsiflexion is usually recommended) is not important in the end, and that fixation can be done in neutral position [19]. Conversely, the distance of the screw relative to the mortise appears to be important. If the screw is too proximal, it can induce widening of the syndesmosis due to fibular deformation. It is recommended to position the screw 1.5 to 3.0 cm above the talocrural joint line to avoid passing through the syndesmosis itself [1]. It must never be more than 4 cm (Fig. 11) [19].

The recommended screw diameter is 4.5 mm; the head volume must not cause any discomfort [25]. This screw better withstands loading than a 3.5 mm diameter screw [26]. The diameter must never be less than 3.5 mm as this may compromise the fixation's stability and lead to early hardware failure [1].

If the reduction is not optimal, rigid fixation brings about excessive stress on the syndesmosis, which will lead to screw failure. This failure does not help with restoring the fibula's anatomical position, contrary to what can be observed during screw removal because of poor reduction [24]. Appearance of synostosis or ossification of the syndesmosis are other complications of rigid fixation [27] that can occur in 50% of ankle fractures, most often in men. They are often incomplete and associated with residual chronic instability [27].

4.3.2. *Endo-button*

To reduce problems related to rigid fixation, some surgeons purpose using an artificial ligament. Its relative flexibility provides adequate compression to maintain the reduction while allowing slight physiological movements of the fibula (rotation and translation) [19]. Endobuttons have some drawbacks and especially

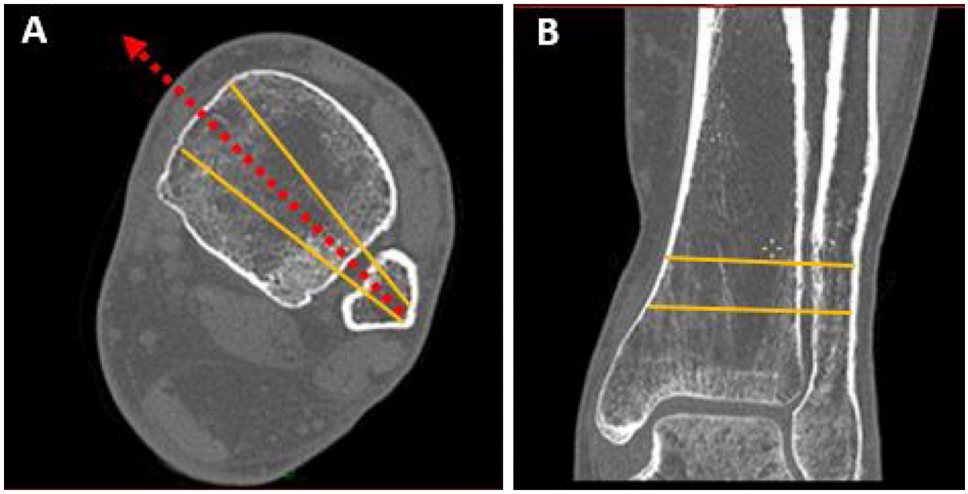

Fig. 10. Ideal positioning of the syndesmosis fixation. A. Axial plane – diverging position of the two fixation methods (screw or endo-buttons); the resultant (red bisecting line) is angled anteriorly by 15 to 30° relative to the talocrural joint to avoid inadequate reduction. B. Frontal plane – the two fixation devices must be parallel to each other and the talocrural joint.

Fig. 11. Ideal placement of the syndesmosis fixation is 1.5–3 cm parallel to the talocrural joint line.

potential lack of stiffness, irritation by the fixation knot, risk of aseptic osteolysis, longer learning curve and higher cost of these implants, which limits their use [19].

4.3.3. *Other methods*

Other fixation methods have been described, although they are not used much: absorbable screws, staples, wire cerclage, K-wires, hooks [19]. Some authors propose doing ligament reconstruction using a tendon autograft (fibularis longus, gracilis and semitendinosus, extensor tendons) or a frozen allograft, although there is no advantage relative to the two main techniques described previously [28].

4.3.4. *Fixation criteria*

Double fixation would help improve the construct's stability and would also prevent rotation defects [29,30]. If two fixation methods are used, they must diverge, with the proximal fixation being more anterior and the distal fixation being more posterior (Fig. 10) [31].

Biomechanical studies appear to suggest that two screws are better than one, but clinical studies have found no significant difference in terms of the radiological and functional outcomes between one and two fixation devices [19,32].

Quadricortical fixation is more rigid and the ankle more stable with more solid cortical support than in cancellous bone. However, the risk of screw failure is higher. In patients with solid bone, tricortical fixation appears sufficient and biomechanically better if open reduction of the fibula is done, with fewer screw failures. Conversely, in patients with weak bone, the risk of screw pullout and these fixation failure is increased [19].

Quadricortical fixation is beneficial in stout, diabetic or osteopenic patients with lower bone mass, while tricortical fixation is mainly indicated in patients with low body mass index (BMI) [19]. One quadricortical screw or two tricortical screws must be used for smaller diastasis and two quadricortical screws for highly unstable DTFS, such as in Maisonneuve fractures [19].

Some authors content that a plate on the lateral malleolus is always preferable (Fig. 12). In osteoporotic patients, adding a plate, even a short one, with two screws at both ends helps to distribute the loads on the plate instead of the two screw heads, to improve the resistance of the screw's torque setting and to prevent stress fractures in case of bone fragility [4,30]. Gardner et al. showed that a plate with two screws is even stronger than two quadricortical screws [30]. Using a locking plate appears to prevent rotational defects since the angular stability of the screws in the plate limits rotational movements of the fibula. Combining an endobutton with a plate has also been described to improve the fibula's reduction and stability [31].

4.4. *Which postoperative protocol should be applied and does the fixation screw need to be removed before weight bearing?*

The postoperative protocol consists of rapid mobilization with weight bearing delayed for 6–8 weeks [1]. When reloading, some ankle mobility, especially in dorsiflexion is needed, which requires

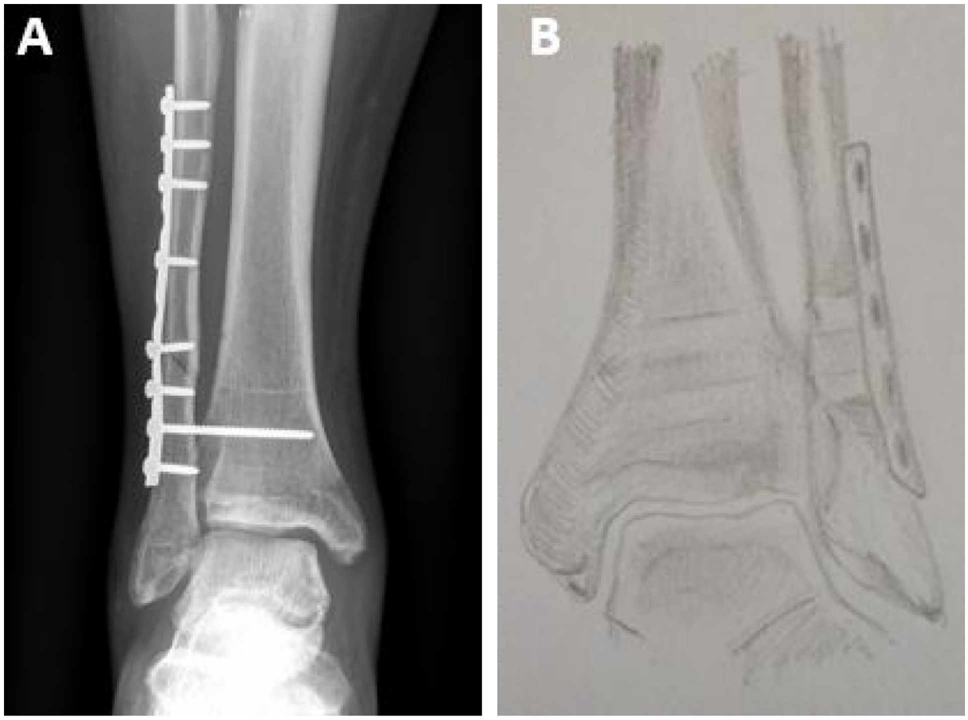

Fig. 12. Use of a lateral plate to reinforce the construct and syndesmosis stability. A. One-third tubular plate fixed by screws, including a syndesmosis screw. B. Same principle with plate fixed by two endobuttons to stabilize the DTFS.

mobility of the DTFS. If the latter is fixed with a screw, its amplitude is reduced and walking transmits much larger stresses to the screw [33]. Over time, the latter breaks under the weight of repeated stresses, often after 3–6 months, when the DTFS has healed. For this reason, some authors insist the screw should be removed just before weight bearing is allowed at 8 weeks [34].

However, this concept is highly controversial, since no clinical or functional benefit of the screw removing before weight bearing has been demonstrated [1,34]. Some authors content that the screw should not be removed before 3 months, and only be removed if it is causing symptoms [1,12,35,36]. If it is left in place, bone weakness (osteolysis around screw in 68–91%) or screw breakage (7–28%) is expected, which allows physiological motion to return to the DTFS [34,37]. These results even appear better compared to situations where the screw stays intact and is left in place [35,37].

Recent systematic reviews conclude that it should be left in place, although the patient must be warned that it will likely break at some point in time and that it will be removed only if it stays intact, is symptomatic and after a minimum of 8 weeks [34]. This avoids having to put the patient through a second procedure, with its associated extra cost and surgical risks.

Conversely, if the syndesmosis is poorly reduced surgically, a correction must be done as quickly as possible to avoid the consequences of chronic instability and post-traumatic osteoarthritis [29]. The simple fact of removing the syndesmosis screw can spontaneously correct the reduction in 89% of cases and thereby improve the functional prognosis [36].

In summary:

- instability with clear diastasis of the DTFS requires surgical stabilization;
- in fracture cases, the distal fibula's length must be restored along with its alignment and its place in the tibial notch. Its anatomical reduction leads to good functional outcomes;
- no matter which fixation device is used on the DTFS, it must be placed between 1.5 and 3.0 cm above the tip of the mortise;
- the main complication is poor reduction, which must be avoided during fixation and verified by an intraoperative or postoperative CT scan;
- removing the screw is strongly recommended if the reduction is poor. In other cases, its removal is highly controversial.

5. What are the clinical and radiological outcomes?

The results of conservative treatment of a DTFS strain without diastasis are excellent in 86–100% of cases with frequent return to sport [1].

Postoperative complications affect about 15% of surgically treated patients:

- infection (4%) is the most serious and often requires removal of the fixation device [38];
- non-healing of the syndesmosis is not rare (39%) and is detected on comparative postoperative CT scans of both ankles. Many are due to poor initial reduction, which is the main complication associated with surgical treatment [1,39];
- poor reduction is found in 64% of cases in the AP plane and 28% in rotation [23]. At 2 years' follow-up, 15% of poor reductions were secondary to open reduction while 44% were secondary to closed reduction [2]. Moreover, of more than 5000 operated ankles, the re-operation rate for poor reduction was only 1.6% [39]. When faced with poor reduction, removal of the device used for syndesmosis fixation can spontaneously correct the reduction in 89% of cases and thus improve the functional prognosis [36]. Recurrence of the diastasis is observed only in a small number of cases; revision surgery typically yields a satisfactory result [40].

Several recent systematic reviews compared the results achieved after rigid fixation (screw) or flexible fixation (endobutton) (Table 1) and suggest that, while the functional outcomes are the same [41], the endobutton improves DTFS motion, and consequently, that of the tibiotalar joint, along with the return to sports

Table 1
Comparison of rigid fixation by screw and flexible fixation by endobutton based on several systematic literature reviews.

	Screw	Endobutton	*p*-value
Functional score (AOFAS)	87.78 [41]	91.06 [41]	
	86.52 [42]	89.56 [42]	
	– [43]	+ [43]	0.000 to 0.049 [43]
Implant removal	40.2% [41]	3.7% [41]	
Screw failure	30.9% [41]	0% [41]	
Inadequate reduction	12.6% [41]	1% [41]	
	22% [42]	0% [42]	
Postoperative complications	16.4% [41]	12% [41]	
	+ (failure & break) [43]	– [43]	0.048 and 0.000 [43]
	+ [44]	– [44]	0.03 [44]
Cost effectiveness	– [45]	+ [45]	
Return to walking/activities	Slower [43]	Faster [43]	0.000 [43]
	Slower [44]	Faster [44]	0.006 [44]

rate at 3 months follow-up [19]. It can also help reduce the rate of hardware removal and poor reductions [41].

If a DTFS tear is diagnosed and treatment occurs more than 1 week after the injury, the window for closed reduction is gone since the bone callus has started to form. Fixation with a single screw can be done during the first 6 weeks after the injury. If the injury is discovered later, a wide range of stabilization techniques exist, ranging from syndesmoplasty by ligament reconstruction (fibularis longus tendon) to reconstructing the AITFL [28,29,46] to tibiofibular fusion when osteoarthritis is present [47]. Beyond 6 months or in cases of persistent instability, the simplest solution is to do a complete fusion of the syndesmosis [46]. Pain will be better controlled, although tibiotalar motion will be lost [12].

6. Conclusion

In fracture case, DTFS tears are common and not only limited to Weber type C fractures. They are difficult to diagnose; thus, dynamic or intraoperative tests must be done.

In instability cases, stabilization must be applied 1.5 to 3.0 cm from the talocrural joint line, preferably as an open procedure to prevent any soft tissue interposition that could perpetuate incorrect reduction, while making sure to avoid rotational and sagittal misalignment.

Routine removal of the fixation device before weight bearing resumes is not recommended. Conversely, malposition or persistent symptoms will require removal of the fixation device, which allow the defect to self-correct and improves function in most cases.

Recurrence of the diastasis is the main reason for revision.

At the chronic stage, fusion of the syndesmosis must be contemplated; the tradeoff for pain relief is loss of mobility.

Disclosure of interest

The authors declare that they have no competing interest.

Funding

None.

Contribution

Julie Manon: review of literature, writing, illustrations, revision.
Karim Tribak: definition of questions, revision.
Dan Putineanu: definition of questions, illustrations, revision.
Olivier Cornu: definition of questions, review of literature, writing, illustrations, revision.

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