Diagnostics in Suspicion of Ankle Syndesmotic Injury

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Abstract

Ankle sprains are among of the most common injuries seen in daily orthopedic practice. Beside injuries of the lateral ligament, which is the most frequently injured single structure in the body of athletes, sprains can also affect the tibiofibular syndesmosis. These injuries are known as high ankle sprains. They can occur with or without a bony injury. In this report, we will discuss the high ankle sprain without any bony injury. These kinds of injuries are rare, but often associated with complications and are frequently misdiagnosed or undiagnosed. The purpose of this article is to provide a clear understanding of clinical tests described in the literature for testing of syndesmotic integrity.

Ankle sprains are among the most common injuries seen in daily orthopedic practice. Besides affecting the lateral ligament, the structure that athletes injure most often, sprains can involve the distal tibiofibular syndesmosis. This joint is stabilized by the anterior tibiofibular ligament, the posterior tibiofibular ligament, and the interosseous ligament.

In 1975, Cedell[1] documented the incidence of syndesmotic sprains as only 1% to 10% of all ankle ligament injuries. Others believe that, in athletes, the incidence may be as high as 40%.[2,3]

In dislocations or fractures, the diagnosis is easy because of obvious clinical and radiographic findings. However, syndesmotic injuries, especially isolated ones, are usually very difficult to diagnose and therefore are often misdiagnosed or undiagnosed.

The association with chronic pain, recurrent pain, formation of heterotopic ossification, and prolonged recovery are the main problems with untreated injuries.[2-6] In a retrospective study, Hopkinson and colleagues[3] found that, compared with third-degree lateral ankle sprains, incomplete injuries of the syndesmosis had almost twice the recovery time. In addition, Boytim and colleagues[2] stated that, compared with athletes with lateral ankle sprains, athletes with syndesmotic sprains had longer recovery times and received significantly more treatments.

Therefore, it is very important for clinicians to evaluate and identify syndesmotic injuries early and to modify rehabilitation adequately.

In this article, we review the clinical tests that can be used to effectively diagnose ankle syndesmotic injuries, and we suggest secondary examinations that can help in making the final diagnosis.

Mechanisms of Injury

In the diagnostics of syndesmotic injury, a careful evaluation of etiology is as essential as the physical examination. Many mechanisms of injury have been described in the literature. The most common include external rotation of the foot,[2,3,7-13] excessive dorsiflexion,[2,3,8,10,11,13,14] and eversion of the talus.[11,13] Other reported components are inversion,[6] plantar flexion,[3,7] pronation, supination,[12] and internal rotation. In a survey of syndesmotic injuries in National Football League athletes, Doughtie[7] reported that external rotation is the prevalent mechanism. Of the 23 athletes registered for that study, 16 reported an external component.

Usually the talus is positioned within the medial and lateral malleoli, with only a small range of motion in rotation. With a forceful external rotation to the forefoot, the talus rotates laterally, pushing the fibula away from the tibia. A stress is thereby applied mainly to the anterior tibiofibular ligament, to the superficial part as well as to the deep part of the posterior tibiofibular ligament (the transverse tibiofibular ligament), and one of these structures can become disrupted. The incidence of syndesmotic injury seems to be high mainly in collision sports, such as football, ice hockey, and soccer.

This kind of injury also has been reported in such athletes as slalom skiers.[15] The main problem in skiing is that the boot does not allow sagittal movement. Ski poles in the snow cause external rotation of the leg and rotation of the body to the opposite side. Excessive external rotation results in an injury of the tibiofibular syndesmosis.

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Figure 1. External rotation test.

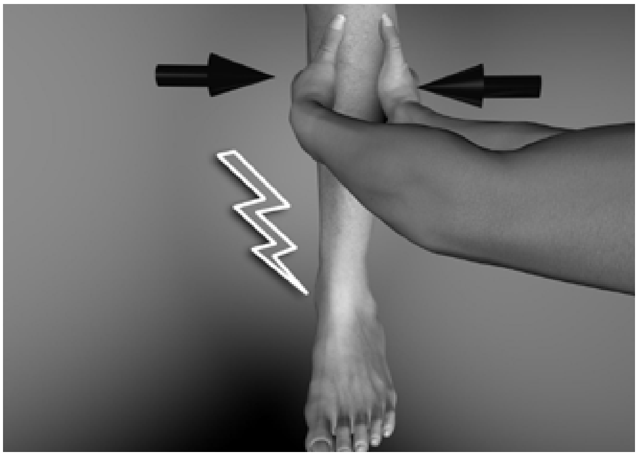

Figure 2. Squeeze test.

The second common mechanism of this injury is hyperdorsiflexion. The superior talar surface is wider anteriorly than posteriorly (mean difference, 4.2 mm).[11] During dorsiflexion, the wider anterior part of the talus is moved between the medial and lateral malleoli, and contact between tibia and fibula is increased to maximum. When there is additional dorsiflexion, the talus pushes the fibula and tibia apart and thereby applies stress to the anterior tibiofibular ligament and the posterior tibiofibular ligament.

In the rare cases of eversion or inversion mechanisms, the lateral and medial malleoli usually fracture before the syndesmosis ligaments rupture.[16]

Overview of Tests

Several tests can be used to effectively diagnose ankle syndesmotic injuries. These tests are performed either through physical examination or imaging. Physical examination tests include the external rotation test,[2,12] squeeze test,[3] dorsiflexion-compression test,[17] palpation test,[6] fibular translation test,[5] heel thump test,[18] crossed-leg test,[15] single-legged hop test,[8] and Cotton test.[19] Imaging tests include traditional radiography, stress radiography, computed tomography (CT), magnetic resonance imaging (MRI), and arthroscopy. The most common clinical tests deserve further description.

Physical Examination Tests

External Rotation Test. Described by Frick[12] and Boytim and colleagues,[2] the test is performed with the patient seated at the border of the examination table with the knee bent to 90°. The examiner uses one hand to stabilize the patient's leg and the other hand to apply external rotation stress to the foot while holding it in neutral position (Figure 1).

Pain over the anterior tibiofibular ligament, posterior tibiofibular ligament, and interosseous membrane is a strong indication of a lesion of the syndesmotic ligaments.

Corresponding to the most common mechanism of injury, increasing external rotation stress to a foot in neutral position leads to external rotation of the talus and to further transactions, such as those already described.

When one of the mentioned ligaments has a tear, passive external rotation causes pain at the anterolateral aspect. Pain on the medial side during the external rotation test, with the foot positioned in plantar flexion, may indicate involvement of the deltoid ligament.[13]

In a retrospective review of patients diagnosed with syndesmotic disruption, Ogilvie-Harris and Reed[5] examined assessment of the external rotation test by comparing the test results before and after surgery. In all patients, the test was reported positive before surgery. After resection of a torn syndesmotic ligament, the syndesmosis was still unstable, but the test was no longer positive in all patients. Therefore, the test does in fact extend the syndesmosis ligament and is an indicator for damage but not instability.

Beumer and colleagues[20] found a mean increase in displacement of only 1 mm after sectioning all syndesmosis ligaments and concluded that all reviewed clinical tests are not capable of demonstrating the mechanical instability.

Some authors have indicated that this test has the best interobserver reliability and that there is a significant relationship between a positive test result and final arthroscopy.[21,22]

Squeeze Test. This test was last described by Hopkinson and colleagues[3] It is performed by using both hands to compress the fibula to the tibia above the midpoint of the calf (Figure 2). The test is considered positive when proximal compression produces distal pain in the area of the tibiofibular ligament and the interosseous ligament.

One would expect that pressing the tibia and fibula together would lead to a decrease in tension in the partially torn ligaments and therefore to a pain reduction, but, in a biomechanical analysis, Teitz and Harrington[23] found that pressing the fibula to the tibia at the midcalf causes a small separation of the syndesmosis.

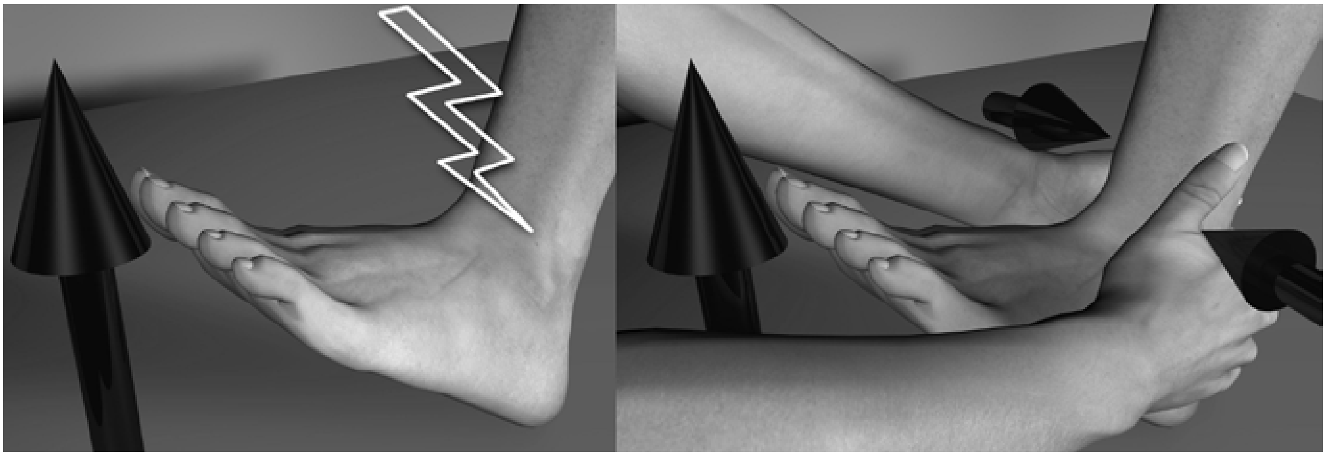

Figure 3. Dorsiflexion-compression test.

For interpretation of this test, it is essential to rule out associated injuries, such as fracture of the tibia and fibula, compartment syndrome of the leg, cellulitis, contusion, lesions of the deltoid ligament, and abrasions,[3] by physical examination and radiographs.

Nussbaum and colleagues[8] reported that a positive test result is useful in predicting the severity of a syndesmotic injury, as their study found that athletes with a positive test result needed a longer rest from activity ($P = .03$).

However, the squeeze test was found to have only moderate reliability[22] and may be sensitive only to large disruptions.[3]

Dorsiflexion-Compression Test. This test is a modification of the passive dorsiflexion procedure described by Ward[17] in 1994. The major difference from that test is that the dorsiflexion-compression test is performed with the patient standing and actively dorsiflexing.[22] Unassisted, the patient reports pain in the area of the syndesmosis. The test is positive when the pain is reduced with the examiner using both hands to compress the malleoli from both sides when a significant increase in range of motion results from compression (Figure 3), or both.

Based on the form of the superior talar surface, hyperdorsiflexion over the normal motion of 15° to 20° forces the fibula to external rotation and stresses the ligaments. With the malleoli compressed, the stress for the ligaments is inhibited.

The "stabilization test" described by Amendola (unpublished data, 2001; Williams and colleagues[19]) is based on a similar foundation. It can be useful in confirming suspicion of an injury of the syndesmosis during the subacute or chronic phase. In this test, several layers of a tape bandage are placed just above the ankle joint to stabilize the syndesmosis. With the ankle taped, the patient stands on his toes. When the pain is less than it was before the ankle was taped, the result is positive.

The reliability of this test is only fair,[22] maybe because of its more complex protocol. However, in the case of a positive test result, combined with a positive external rotation test, patients took significantly longer to return to preinjury activities[19] than did patients with a negative test result.

Cotton Test. This test, one of the oldest, was described in 1910 by Cotton[24]. Originally it was used to diagnose an ankle fracture.

The test is performed by stabilizing the distal tibia and translating the talus in the mortise from medial to lateral[19] (Figure 4). During the test, the ankle should be in neutral position because plantar flexion may obtain false-positive results.

The test is positive when more movement is felt in comparison with the opposite side or when pain is remarkable. After the results of Beumer and colleagues,[20] as already mentioned, pain should be the deciding criterion. A positive test may suggest syndesmotic involvement as well as a deltoid ligament injury.

Although the sensitivity of this test is only moderate, a significant relationship between the test result and the final arthroscopic diagnosis could be shown.[21]

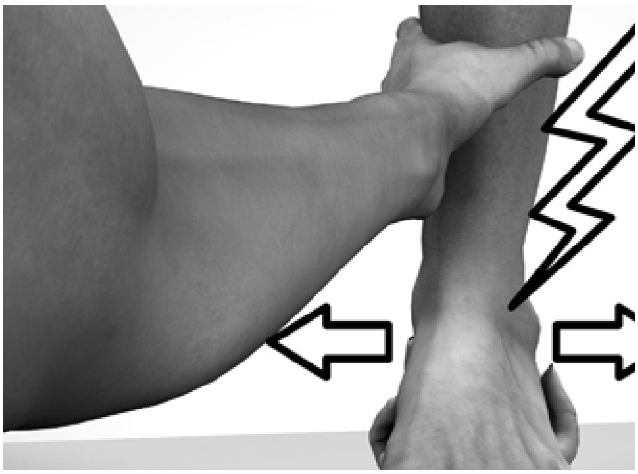

Figure 4. Cotton test.

Besides being useful in clinical diagnosis, the Cotton test is one of the most common intraoperative maneuvers in evaluating syndesmotic stability after fibula fixation.[18] The test is performed by a direct lateral pull of the fibula with a clamp or a small hook. During surgery, the test is positive when the fibula can be laterally displaced more than 1 cm.

Imaging Tests

Traditional Radiography. When an injury of the syndesmosis is suspected, ankle imaging should begin with plain radiographs. Included in almost 50% of all syndesmotic injuries is an osseous avulsion in the anterior or posterior aspect of the tibia. Plain radiographs are used to look for fractures and osseous avulsion and to evaluate syndesmotic widening.

Common views include weight-bearing anteroposterior (AP), lateral, and mortise views of the ankle. The mortise view, a 20° internal oblique AP radiograph, is taken with the patient positioned in unilateral weight-bearing.

In patients with possible syndesmotic injuries or tenderness in the area of the proximal fibular, AP and lateral radiographs of the complete tibia and fibula are essential for excluding a Maisonneuve, Pott, or Dupuytren fracture.

Three radiographic measurements may be made on AP and mortise radiographs to identify a syndesmotic injury.

The first, the so-called tibiofibular clear space or la ligne claire, is defined as the distance between the lateral border of the posterior tibial tubercle and the medial border of the fibula and is measured on AP and mortise radiographs 1 cm proximal to the distal tibial articular surface. The anatomical interval that illustrates the clear space is the posterior aspect of the tibiofibular syndesmosis, as shown in a cadaveric study by Harper.[25] A distance of less than approximately 6 mm measured on AP and mortise views seems normal.[26] Internal rotation of the fibula to the tibia increases the tibiofibular clear space; external rotation reduces it.

Next, tibiofibular overlap is the maximal horizontal distance between the medial border of the distal fibula and the anterior distal tibial tubercle measured on AP and mortise views. Overlap should be more than approximately 1 mm on the mortise view and about 42% or more of the total fibular width on the AP view.[26] Ostrum and colleagues[27] analyzed the anatomy of intact syndesmotic ankles and found noticeable differences between the sexes. They reported that tibiofibular overlap (TFO) of more than 2.1 mm in women and 5.7 mm in men indicates an intact syndesmosis and produced a formula for predicting normal tibiofibular overlap: $TFO = 0.862 \times LT - 2.62$ (LT = distance from lateral tibia to incisura fibularis on AP radiographs; 1 cm proximal to tibial plafond).

Medial clear space—the distance between the medial border of the talus and the lateral articular surface of the medial malleolus at the level of the talar dome—is another relevant measurement. Medial clear space of more than 4 mm on mortise view is considered abnormal,[28] and medial clear space larger than superior clear space indicates a lesion of deltoid ligament.[9]

Also very important, according to Sclafani,[29] is a congruent joint on a lateral radiograph. When the syndesmotic ligaments are injured, the parallelism of the cortical line of the distal tibial articular surface and the talar dome is often lost. In addition, in an intact ankle joint, the medial malleolus should be lightly projected anterior to the lateral malleolus.

The sensitivity, specificity, and accuracy of standard AP radiographs in the diagnosis of tibiofibular syndesmotic disruption were 43%, 100%, and 75%, respectively, and the sensitivity, specificity, and accuracy of mortise radiographs were 65.2%, 100%, and 84.6%, respectively.[30]

Standard AP and mortise radiographs are useful in diagnosing fractures and evaluating ligamentous ligament injuries, but the accuracy of these methods is not satisfactory, so other diagnostic tools must be applied.

Stress Radiography. For identification of syndesmotic injuries, some authors have recommended stress radiographs as a diagnostic possibility.

With the upper part of the lower extremity stabilized, external rotation and lateral displacement force are applied to the ankle. Measured distances are compared with those of the noninjured, contralateral leg.

Stress mortise radiograph measurements had only a small correlation with anatomical diastasis, so when posterior displacement of the fibula is suspected, assessment of syndesmotic ligament disruption should be made on lateral radiographs.[31] In addition, the interobserver correlation was significantly higher on lateral radiographs than on mortise radiographs.[31] Last, evaluation of diastasis with lateral radiographs seems to be more reliable than evaluation with use of mortise radiographs.

Measurements were made to assess the position of the fibula with respect to the anterior cortex of the tibia. First, a line connecting the anterior and posterior distal angles of the chondral-osseous transit was drawn. Then, 2 lines perpendicular to that horizontal line were drawn—one on the anterior angle (line A) and the other at the anterior intersection of the fibula and the distal tibial articular surface (line B). The distances between these 2 lines was then measured.

Computed Tomography. CT may be necessary when the symptoms of an injured syndesmosis are chronic or when a clinical diagnosis is not possible. CT is more sensitive than radiography. The measurement is taken 1 cm above the articular surface between the medial part of the fibula and the deeper posterior area of the incisura fibularis. In a cadaver study, Ebraheim and colleagues[32] found that normal radiographs could not detect a 2-mm diastasis and could detect a 3-mm diastasis in only 50% of cases, whereas these distances were visible with CT. Therefore, CT is more sensitive for demonstrating minor or partial ruptures of syndesmotic ligaments.

Magnetic Resonance Imaging. The disadvantage of CT is that it may detect only osseous structures, and injuries to surrounding structures may go undetected.

MRI is a diagnostic tool for assessing musculoskeletal injuries, and high-resolution MRI can effectively image the structures of the syndesmosis.[33]

During MRI, the foot should be placed in neutral position. Only axial views were used, as they are the most useful for evaluating tibiofibular syndesmosis.[28,33-36] For complete evaluation, the protocol provided T_1- and T_2-weighted images to display the ligament, surrounding structures, and edema.

Vogl and colleagues[36] provided 4 diagnostic criteria for identifying an injury to ligament structures: abnormal course; irregular contour; increased signal intensity on T_2-weighted sequences or on plain T_1-weighted sequences; and marked enhancement on T_1-weighted images with contrast. With respect to ligament disruption, additional criteria are ligament discontinuity, and either wavy or curved ligament contour, or nonvisualization of ligament.[35]

Often visualized as well is a surrounding edema or bleeding, but even these features can complicate diagnosis by MRI. Bleeding of a torn ligament is a helpful sign, but if there is a fibular fracture next to the tibiofibular ligaments, blood from the fracture can make visualization of the ligament difficult.[35]

Brown and colleagues[37] indicated a significant association of acute syndesmotic injuries with osteochondral lesions, bone bruises, and tibiofibular recess height.

The sensitivity, specificity, and accuracy of MRI were 100%, 93.1%, and 96.2%, respectively, for diagnosis of a tear of the anterior tibiofibular ligament and 100%, 100%, and 100% for diagnosis of a tear of the posterior tibiofibular ligament.[30] Some authors believe that use of magnetic resonance arthrography (MRA) to detect contrast material between the tibiofibular articulation helps support the value of MRI.[38]

Arthroscopy. Arthroscopy allows obvious visualization of all syndesmotic ligaments, except the proximal part of the tibiofibular interosseous ligament, so its use leads to an accurate diagnosis of any tear.

Hintermann and colleagues[39] described a set of anatomical abnormalities and pathologic variances found in ankle arthroscopy: synovitis, synovial plicae, changes in other ligaments (eg, anterior talofibular ligament, calcaneofibular ligament, deltoid ligament), and cartilage lesions in the talus or tibia. All must be excluded through arthroscopic examination, as they can also lead to chronic pain and permanent ankle instability.

For evaluation of syndesmotic ligaments, the arthroscope is inserted through anterolateral and anteromedial portals. The anterior tibiofibular ligament is best judged from the anteromedial portal, and the posterior tibiofibular ligament from the anterolateral portal.

An abnormal course or discontinuity of the ligament, a decrease in its tension, an avulsion at its attachment to the fibula and tibia, and a positive arthroscopic stress test are diagnostic criteria for a torn ligament.[30] The stress test of the distal tibiofibular joint is performed by moving the ankle from internal rotation to external rotation. During this movement, the maximum opening of the tibiofibular joint should be observed. In normal ankles, there is only about 1 mm of movement between the fibula and the tibia[5]; instability can be supposed if the opening is more than 2 mm.

A typical triad of intraoperative findings is scarring of the posterior tibiofibular ligament, disruption of the interosseous ligament, and chondral damage to the posterolateral tibial plafond.[5]

Takao and colleagues[30] reported accuracy of 100% in identifying patients with syndesmotic injuries.

Conclusion

Syndesmotic injuries, though common, are difficult to evaluate. When they occur in the ankle, they require longer periods for full recovery and can result in pathologic changes, such as characteristic interosseous calcification, arthrosis, and chronic ankle instability. Given these potential outcomes, early diagnosis is as important as adequate treatment for promoting rapid return to preinjury activity level.

A positive diagnosis can be suspected clinically when the patient has tenderness and swelling over the deltoid and syndesmotic ligaments. A thorough physical examination and an accurate understanding of the mechanism of injury are essential in making the correct diagnosis. Plain radiographs should be carefully examined to rule out a change in position between tibia and fibula. If necessary, stress radiographs should be obtained. When doubt exists, another imaging study (CT, MRI, or MRA) should be added to the diagnostics.

If the diagnosis is still in doubt, and there is strong suspicion of a syndesmotic disruption, an ankle arthroscopy may be necessary for definitive diagnosis of a syndesmosis ligament injury.

We hope that clinicians reading this article will become sensitized to this injury and that it will provide them with information they can use on their way to a correct diagnosis.

Authors' Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

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