High Ankle Sprains and Syndesmotic Injuries in Athletes

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Abstract

Treatment of athletes with ligamentous injuries of the tibiofibular syndesmosis can be problematic. The paucity of historic data on this topic has resulted in a lack of clear guidelines to aid in imaging and diagnosing the injury, assessing injury severity, and making management decisions. In recent years, research on this topic has included an abundance of epidemiologic, clinical, and basic science investigations of syndesmotic injuries that are purely ligamentous or associated with ankle fracture. Several classification systems can be used to classify ligamentous injury to the syndesmosis. These systems integrate clinical and radiographic findings but do not address the location of the injury or its severity. Injury to the syndesmosis can be purely ligamentous; however, many unstable syndesmotic injuries are associated with fractures. Nonsurgical management can be used for stable ligamentous injuries without frank diastasis, but surgical management, including screw or suture-button fixation, is indicated for fractures with unstable syndesmotic injuries.

I njuries to the distal tibiofibular syndesmosis, including stable ligamentous injuries and complete, unstable syndesmotic injuries with complete ligamentous disruptions with or without an associated fracture, have been increasingly recognized in athletes. Management of these common injuries is important because they can result in substantial missed time from sports, may require surgical stabilization, and are associated with long-term ankle dysfunction.[1,2] Recent clinical evidence exists to support the potential advantages and use of new treatment techniques and implants for the athletic population.

Anatomy and Biomechanics

The anatomy of the syndesmosis has been well described.[3] Syndesmotic stability is conferred by both osseous and ligamentous relationships between the distal tibia and fibula. The fibula rests within a concave triangular groove (ie, incisura) in the tibia, with its apex 6 to 8 cm proximal to the talocrural joint.[3] The anterior-inferior tibiofibular ligament (AITFL), interosseous ligament (IOL), interosseous membrane, posterior-inferior tibiofibular ligament (PITFL), and inferior transverse ligament compose the syndesmosis (Figure 1). The deltoid ligament also contributes to syndesmotic stability as a strong restraint to lateral shifting of the talus.[4] The AITFL has a broad origin on the anterior tubercle of the distal tibia, approximately 5 mm superior to the articular surface, and runs obliquely in a distal-lateral direction, narrowing as it inserts on the distal anterior fibula. The PITFL extends from the posterior malleolus
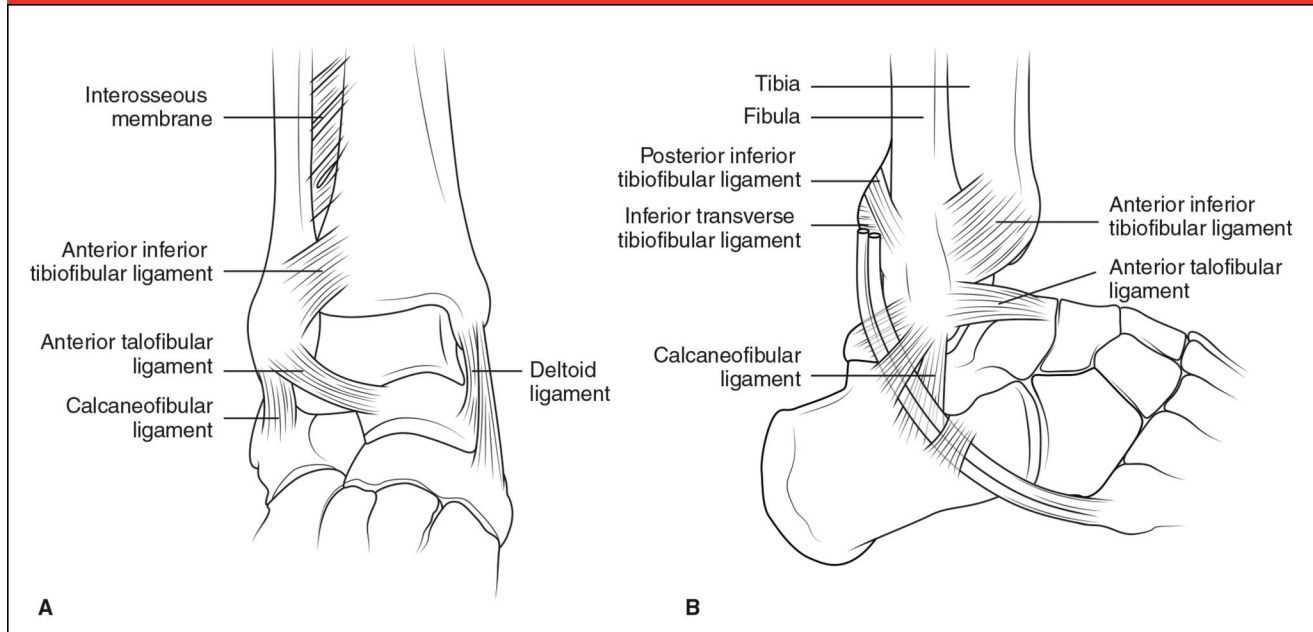
Figure 1

Illustration of the AP (**A**) and lateral (**B**) views of the ankle joint demonstrating the osseous and ligamentous anatomy of the syndesmosis. (Adapted with permission from Browner B, Jupiter J, Levine A, Trafton P: *Skeletal Trauma: Fractures, Dislocations, Ligamentous Injuries*, ed 3. Philadelphia, PA, Saunders, 2003, vol 2, p 2307-2374.)

of the tibia and inserts posteriorly on the fibula. The fibrocartilaginous inferior transverse ligament inserts posteromedially on the distal fibula, deepening the posteroinferior rim. The interosseous membrane spans the apex of the incisura tibialis to just above the level of the talocrural joint, where it becomes the IOL.[3]

The syndesmosis is an inherently stable articulation that allows motion in coronal, sagittal, and transverse planes. Radiostereometric evaluation of normal ankles by Beumer et al[5] showed that, with an external rotation moment of 7.5 Nm applied to the foot, the fibula rotates externally 2° to 5° and translates posteriorly 1 to 3.1 mm. These displacements cannot be measured reliably on conventional stress radiographs.[5,6] In a cadaver study, Xenos et al[4] evaluated the ligamentous structures of the tibiofibular syndesmosis. The authors sectioned the ligaments and measured the diastasis in both loaded and unloaded states. With external rotation force, the tibiofibular diastasis was 2.3 mm after sectioning of the AITFL, 5.5 mm with the additional sectioning of the distal IOL, and 7.3 mm after sectioning of the PITFL. Thus, alteration in joint mechanics can occur even with a moderate injury to the syndesmosis.

Incidence and Epidemiology

Syndesmotic injuries are more common in sports that have high-speed collisions, artificial surfaces, uneven terrain, and high-torque cutting and jumping forces that can result in dorsiflexion and external rotation of the foot relative to the ankle and tibia (eg, football, soccer, basketball, rugby, skiing, hockey).[7,8] Ligamentous injuries to the syndesmosis are

commonly referred to as high ankle sprains because they occur proximal to ligaments that are more commonly injured during lateral inversion sprains (ie, anterior talofibular ligament and calcaneofibular ligament). More severe (ie, complete) ligamentous injuries can occur but are uncommon without fracture and typically require surgical stabilization.[7] High ankle sprains, which are less common than inversion ankle sprains, comprise up to 12% of all ankle sprains[9] but represent up to 25% of ankle sprains in collision sports, such as American football.[2,7,9] Hunt et al[7] showed that most syndesmotic injuries occur during contact with another player and are 14 times more likely to occur in games than in practices in collegiate football. Compared with inversion sprains, high ankle sprains are also more likely to create long-term dysfunction[2] and require significantly more time for recovery and return to sport.[2,10]

Mechanism of Injury

Classic syndesmotic injuries occur when the foot is subjected to an external rotation force while in a dorsiflexed position. The talus forces the fibula to separate from the tibia, rotate externally, and displace posteriorly,[11] resulting in abnormal stress on the syndesmotic ligaments. Laboratory studies have shown that foot position affects the nature of the injury. Haraguchi and Armiger[12] demonstrated that external rotation of the foot while in pronation results first in damage to the AITFL, followed by medial injury to the anterior deltoid ligament. Wei and colleagues[13,14] highlighted the importance of eversion during an external rotation-producing AITFL injury, whereas external rotation in a neutral position primarily produces deltoid ligament failure. In

a separate study, Wei et al[15] demonstrated the influence of shoes with flexible uppers on talus motion. These shoes allow greater talar eversion and transfer more stress to the AITFL. Thus, the level of shoe constraint may also contribute to syndesmotic injury.

In a study of 60 athletes with syndesmotic sprains, Nussbaum et al[16] found that 55% of sprains were caused by a collision while the foot was planted and externally rotated, resulting in a forward fall that caused further dorsiflexion. Sport-specific injury patterns can also occur. In a skier or hockey player, high-torque external rotation of the foot can occur when the inside edge of a ski or skate is caught. Although external rotation is the most common mechanism associated with syndesmotic injury, combined syndesmotic and lateral ankle ligament strains do occur. Uys and Rijke[17] found that a high-grade injury to the syndesmosis was typically associated with minimally traumatized lateral ankle ligaments, whereas a low-grade injury may be associated with concurrent low- and high-grade lateral ligament sprains. In a study of 56 patients with lateral ankle sprains, de César et al[18] found that the rate of concomitant syndesmotic injury was 17.8%. This underscores the need for a careful examination of ankle injuries, regardless of the reported mechanism of injury, particularly given the possibility of concomitant ligamentous injury.

Diagnosis

A thorough history can often uncover mechanisms of injury that heighten suspicion for injury to the syndesmosis. Pain is often diffuse, but it is generally located anterolaterally and/or posteromedially at the level of the ankle joint. Physical examination includes inspection of the joint for

swelling and palpation for tenderness. The distance that tenderness extends proximal to the ankle joint has been termed "tenderness length" and has been correlated with the time to return to sports.[19]

The provocative tests used to evaluate an acute syndesmotic injury include the squeeze, external rotation stress, Cotton, fibular translation, and the cross-leg tests. The squeeze test is performed with the patient sitting on the edge of the examination table and the knee bent 90°. A compressive force is applied between the fibula and the tibia superior to the midpoint of the calf using one or both hands. A positive test indicates syndesmotic injury. The external rotation test is positive if pain is reproduced with external rotation of the foot and ankle relative to the tibia. Caution should be used to stabilize the tibia but not the fibula during this test to avoid a false-positive result. The Cotton test is performed by translating the talus medial to lateral within the mortise; increased translation or pain suggests deltoid ligament disruption associated with a syndesmosis injury. The fibular translation test is performed by stabilizing the tibiotalar joint with one hand and translating the fibula anterior and posterior with the other hand. Pain and increased translation relative to the uninjured side indicate a positive test. The crossed-leg test is performed by instructing the patient to place the injured leg across the kneecap of the opposite leg, with the pivot point at the junction of the middle and distal thirds of the tibia. Pain reproduced with gentle force on the medial knee indicates a positive test.[20] In addition, the stabilization test, originally described by Williams et al,[21] can be used to evaluate a chronic injury. This test is performed by tightly taping the patient's leg just above the ankle joint in order to stabilize the syndesmosis. A positive test

Figure 2
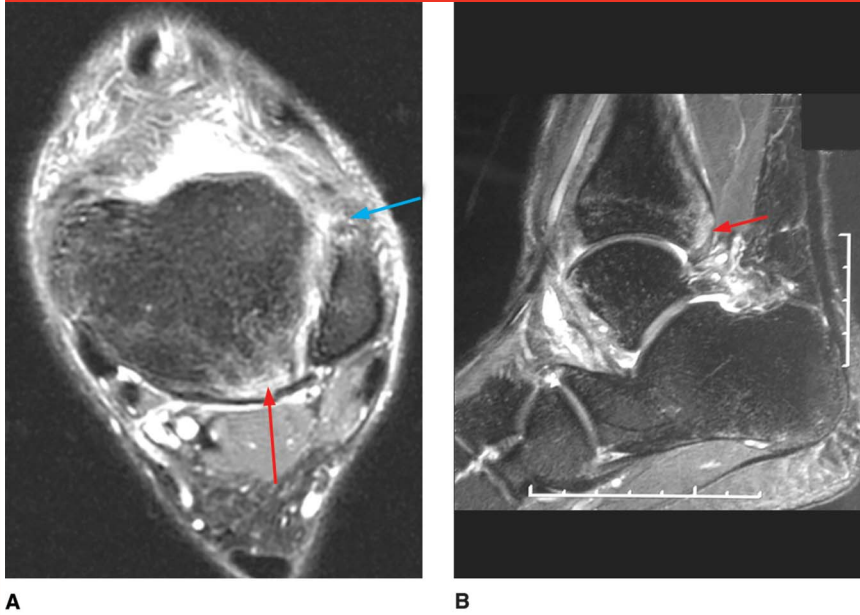
Axial (**A**) and sagittal (**B**) T2-weighted magnetic resonance images of the ankle joint demonstrating a moderate injury to the syndesmosis. Note the subcutaneous edema and effusion as well as the complete injury to the anterior-interior tibiofibular ligament (blue arrow) and the posterior malleolar edema (red arrows) with an intact posterior-inferior tibiofibular ligament.

is indicated if toe raises, walking, and/ or jumping are less painful after taping. No individual test is diagnostic, but a combination of sensitive and specific tests can lead to an accurate diagnosis or further workup.[22]

In a recent meta-analysis, the diagnostic accuracy of physical examination findings was reviewed, and the dorsiflexion external rotation test was found to be the only test with high intra-rater and inter-rater reliability; no single test has been found to have high diagnostic accuracy.[23] The Cotton and fibula translation tests have poor inter-rater reliability.[23] de César compared MRI-confirmed syndesmotic injuries in the setting of concomitant lateral ankle sprains and found that the squeeze test was more sensitive and specific than the external rotation test (30% versus 20% and 93.5% versus 84.8%, respectively).[18]

Standard imaging should include plain weight-bearing radiographs to identify fracture or frank tibiofibular diastasis. MRI can be useful for evaluating a syndesmotic injury. In a study of 52 patients with a potential tear of the AITFL, Takao et al[24] found that the standard 1.5-T MRI had a sensitivity, specificity, and accuracy of 100%, 93%, and 96%, respectively. MRI can show both the extent of ligament injury and the presence of nondisplaced fractures or bony edema, which can contribute to pain distribution (Figure 2). A study of MRI findings in professional football players with syndesmotic injuries demonstrated that increased injury grade was an important predictor of prolonged disability, and tenderness length correlated with time to return to sports.[19]
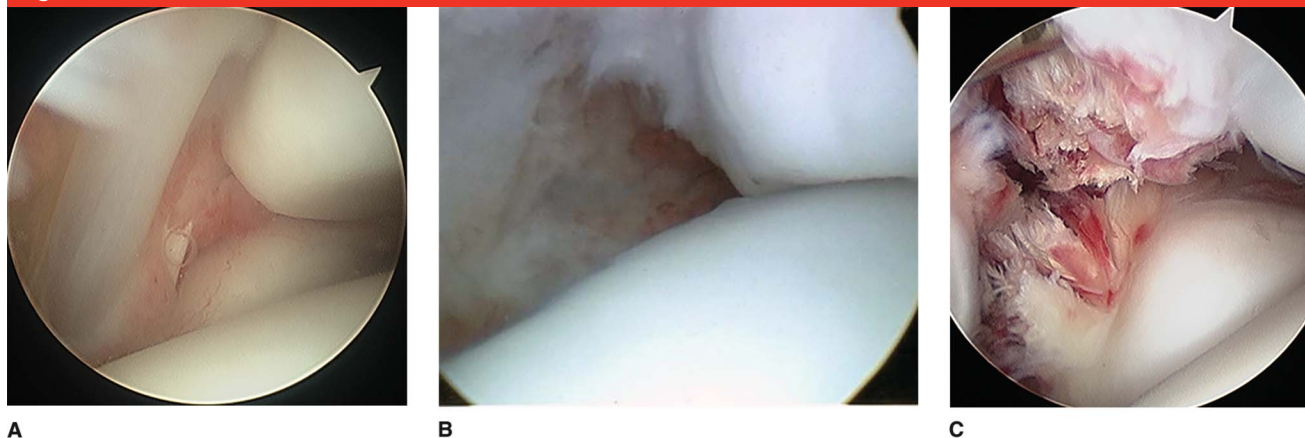
Classification

Several classification systems can be used to categorize ligamentous injury to the syndesmosis.[2,25,26] Each of these systems integrates clinical and radiographic findings, but no current classification system incorporates the location or the severity of ligamentous injury based on advanced imaging (eg, MRI, CT, ultrasonography). Thus, given the wide spectrum of ligamentous disruption in grade II injuries, no system currently provides an adequate guide to treatment or prognosis.

In each classification scheme, the injury is graded by severity, with the least severe categorized as grade I and the most severe as grade III. Although the classification schemes have similarities, there are important differences. In general, grade I injuries are clinically mild, with a stable syndesmotic joint, normal radiographic findings, and incomplete injury to the lateral ligaments. Grade II (ie, moderate) injuries are typically associated with partial syndesmotic ligament disruption, normal radiographic findings, and positive external rotation and squeeze tests. However, no consensus exists regarding joint stability. Scranton[26] suggests that grade II injuries are unstable, whereas Wolf and Amendola[25] believe that these injuries can be stable or unstable. Current classification systems are insufficient for differentiating between grade II injuries that require stabilization and those that do not. Finally, grade III (ie, unstable) injuries include complete injury to the syndesmotic ligaments (ie, AITFL, IOL, PITFL, deltoid). Plain radiography shows clear widening of the medial clear space and/or syndesmosis, and all clinical tests are positive.

Management of grade II (moderate) injuries is predicated on the dynamic instability of the syndesmosis or the medial clear space. As suggested earlier, instability can be very difficult to assess with plain radiography. Stress radiography, MRI, or arthroscopy can be used to

Figure 3

Arthroscopic images demonstrating a normal syndesmosis (**A**) and stable (**B**) and unstable (**C**) syndesmotic injuries.

confirm the injury pattern and the presence of instability, but these findings are not included in current classification schemes (Figures 3 and 4). When routine and stress radiographs are normal in patients with grade II injuries, patient history, physical examination, advanced imaging, and possibly arthroscopic evaluation need to be considered.

Management of Syndesmotic Injuries

Purely Ligamentous Injuries

In general, athletes without frank diastasis or dynamic instability on weight-bearing or stress radiographs can be treated nonsurgically.[16] The athlete should be informed that recovery from a syndesmotic injury takes longer than that for an inversion ankle sprain and may require more extensive treatment.[10] Nussbaum et al[16] found that the time to return to full competitive activity was directly associated with the level of tenderness along the interosseous membrane.

The rehabilitation process is implemented in three phases: acute (I), subacute (II), and integration to

Figure 4
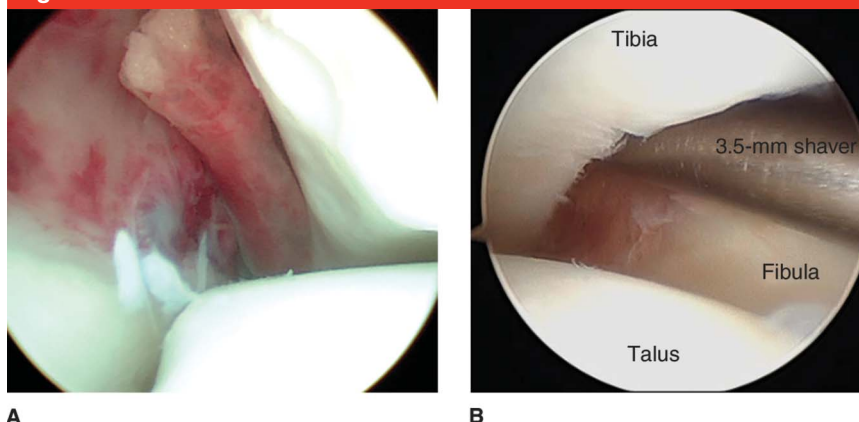
Arthroscopic images of the syndesmosis demonstrating a complete syndesmotic injury with hypertrophic synovium (**A**) that confirms syndesmotic instability, and the placement of a 3.5-mm shaver into the syndesmosis (**B**).

sport (III)[21] (Table 1). The protocols for each phase of rehabilitation are tailored individually to achieve the goals of joint protection, minimization of inflammatory response, and pain control for the acute phase; restoration of mobility, strength, and gait for the subacute phase; and increased strength, neuromuscular control, and sports-specific tasks for the last phase. Grade III injuries in athletes are relatively uncommon and are typically managed surgically. The principles and methods of fixation are

similar to those used for fractures with syndesmotic instability.

Fractures With Syndesmotic Instability

Many unstable syndesmotic injuries are associated with fractures; thus, most of the literature focuses on surgical management of fractures with unstable syndesmotic injuries. When these injuries occur, surgical anatomic reduction of the fracture and stabilization of the syndesmosis, if necessary, are typically indicated.

Table 1

Phases of Rehabilitation for Athletes With High Ankle Sprain

Phase	Day	Description
I	1–4	Nonweight bearing, crutches or knee scooter
		Removable CAM boot used to reduce swelling, pain, and inflammation
		Gentle manual resistance exercises, active-assisted exercises, and passive motion as tolerated
II	4–7	Protected weight bearing with crutches, wean from crutches as able
		Continue motion and resistance exercises and swelling reduction modalities
		Weight-bearing exercises, seated heel raises, light proprioception added
II	7+	Weight bearing as tolerated, continue phase II modalities
		Functional exercises begin: double standing heel raises and hops, then single heel raises and hops
		Integrate position-specific drills, jogging, running, cutting, jumping, dynamic explosive maneuvers
		Ankle brace and/or taping for return to sport

Adapted with permission from Nussbaum ED, Hosea TM, Sieler SD, Incremona BF, Kessler DE: Prospective evaluation of syndesmotic ankle sprains without diastasis. *Am J Sports Med* 2001;29(1):31-35.

Figure 5

Illustration of the AP view of the ankle joint demonstrating important landmarks that are assessed on ankle radiographs. (Adapted from Wuest TK: Injuries to the distal lower extremity syndesmosis. *J Am Acad Orthop Surg* 1997;5 [3]:172-181.)

Fibular and Medial Malleolar Fractures

Fibular fractures commonly occur with syndesmotic injury. Open reduction of the fracture to correct length and rotation can result in an anatomic reduction of the syndesmosis.[27] High fibular fractures (ie, Maisonneuve fractures) are associated with more extensive interosseous disruption and syndesmotic instability and can often be indirectly reduced. However, open reduction is indicated if shortening or malrotation of the fibula is suspected. Although radiography is helpful for delineating fractures, prediction of a syndesmotic injury based on the fracture pattern and location on preoperative radiographs can be misleading in up to one third of cases.[28] Current evidence supports primary repair of an associated injury to the deltoid ligament only in the setting of suspected interposition of capsular tissues or a hematoma that is blocking reduction after anatomic reduction of the fibular fracture.[29] In these cases, a medial approach should be considered. When medial malleolar fractures are present, they should be anatomically reduced and fixed with lag screws.

Posterior Malleolar Fractures

The posterior malleolus contains the tibial PITFL attachment. Biomechanical and clinical evidence suggests that fixation of displaced posterior malleolar fractures can be beneficial for syndesmotic stability and reduction. In a study of 15 patients with pronation-external rotation stage 4 ankle injuries with posterior malleolar fractures, Gardner et al[30] found that the PITFL remained intact. The authors also reported a mechanical advantage to posterior malleolar fixation over syndesmotic fixation. A subsequent study by Miller et al[31] demonstrated comparable clinical and radiographic outcomes with posterior malleolar fix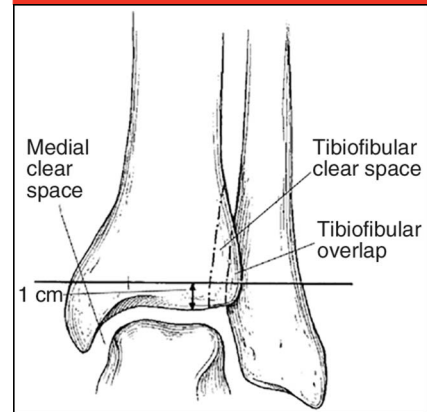ation, syndesmotic fixation, and combined fixation at a mean follow-up of 15 months. Reduction and fixation of the posterior malleolar fragments are typically indicated when the fragment is displaced and larger than 25% to 33% of the plafond.[32] Fixation can be performed using screws or a buttressing plate-and-screw construct.

Syndesmotic stability should always be assessed after fracture fixation regardless of pattern. The hook test and external rotation stress test can both be performed under fluoroscopic evaluation. In the hook test, the fibula is translated laterally, typically by applying a lateral translation force on the foot. Widening of the syndesmosis or medial clear space indicates a positive test. Both of these intraoperative tests have a high specificity but a moderate to low sensitivity.[33] Normally, tibiofibular overlap should be maintained, and the tibiofibular clear space should not exceed 6 mm for the hook test. The medial clear space should not exceed 4 mm total for the external rotation stress test (Figure 5). Maintaining the hindfoot in varus while applying an external rotation

force has been shown to improve the sensitivity of radiography in detecting a combined injury to the deltoid ligament and syndesmosis.[34] When the results are equivocal, ankle arthroscopy can be used to confirm instability and reduction.

Syndesmotic Fixation

Syndesmotic Screws

Screw fixation remains the most common fixation method for syndesmotic injuries. Despite extensive biomechanical and clinical research, no consensus exists on several aspects of screw fixation, including the screw size, number of screws, number of cortices involved, location of fixation, postoperative care, and the need for implant removal.[35] Adequate stabilization of the syndesmosis throughout the healing period can be achieved with 4.5-mm or 3.5-mm screws. However, the larger screws have not been shown to offer a superior biomechanical advantage over the smaller screws.[11] Although the 4.5-mm screws are less likely than the 3.5-mm screws to break, greater fixation strength may not be clinically necessary or desirable (Figure 6). Ease of screw removal is one benefit of using 4.5-mm screws, but these screws leave a larger defect in the tibia and fibula, which can be a potential stress riser.

The number of screws used can affect the stability of syndesmotic fixation. In a three-dimensional motion analysis of cadaver specimens, Huber et al[36] found that screw fixation resulted in nonphysiologic stabilization of the fibula regardless of the number of screws used or the number of cortices involved. Markolf et al[11] found that the number of cortices involved in fixation of the syndesmosis demonstrated no significant effect on the mechanical stability of the distal fibula in a simulated loading test. In a randomized controlled trial of 120 patients with syndesmotic


Figure 6

Postoperative AP radiographs of the ankle in a high school football player following surgical fixation of a syndesmotic injury with screws before (**A**) and after (**B**) asymptomatic implant failure.

disruption, no difference was reported between three- and four-cortex fixation in terms of loss of reduction, screw breakage, or the need for implant removal.[37] However, a trend toward higher loss of reduction was reported in patients with tricortical fixation and in those who did not comply with weight-bearing restrictions.

Screws are generally placed 2 to 5 cm proximal and parallel to the ankle joint to avoid injury to the articular surface. To avoid an injury to the perforating branch of the peroneal artery, screws should be placed 2.3 to 4.1 cm proximal to the joint in women and 2.8 to 5.9 cm proximal to the joint in men.[38] Screws should be directed anteriorly along the intermalleolar axis to avoid malreduction.[39]

Although no consensus exists on the optimal postoperative care after syndesmotic fixation, most surgeons recommend a non–weight-bearing status for a minimum of 4 to 6 weeks to prevent fixation failure.[40] In athletes, syndesmotic screws are routinely removed at a minimum of 8 weeks, but screw removal at 12 weeks is ideal.[41] However, good evidence is lacking to

Figure 7
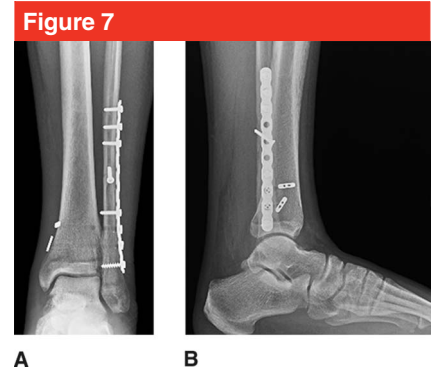
Postoperative AP (**A**) and lateral (**B**) radiographs of the syndesmosis in a collegiate soccer player demonstrating plate fixation for fracture stabilization and a suture button construct for stabilization of the syndesmosis.

support routine screw removal in the general population.[42] Given the physiologic motion at the syndesmosis, screws may loosen or break when left in place. Recent retrospective series have suggested that patients with loosened or broken screws have outcomes similar to those of patients with intact screws.[43] One study reported a complication rate of up to 22.4% associated with screw removal.[41] Based on the available data, screw removal should be reserved for patients with intact screws that cause irritation or reduced range of motion for 4 to 6 months.[44]

Suture Button Construct

The suture button is a relatively new surgical implant that consists of a strong suture loop tensioned and secured between two metallic buttons that abut the outer cortices of the tibia and fibula or the fibular plate, when present (Figure 7). The suture button construct provides stabilization of the ankle mortise without the need for device removal. This device has emerged as an alternative to screws for syndesmotic stabilization.[45,46] The stability of the construct is related to the tension force between the metallic buttons resting against

the cortices of the distal fibula and tibia. The indications for fixation with a suture button have not yet been well defined. Although biomechanical studies are inconclusive as to whether the suture button can provide fixation strength comparable to that of screws, the device does appear to offer more physiologic motion between the distal tibia and fibula.[47,48]

The clinical literature on suture button fixation is limited, but recent studies have reported encouraging results.[45,46,49,50] Clinical outcomes of fixation with the suture button device were equivalent[50] or superior[49,51] to those achieved with syndesmotic screw fixation involving four cortices. Successful outcomes have been reported in several clinical studies in which suture button fixation was used to manage isolated injuries to the syndesmosis and combined injuries to the syndesmosis with rotational ankle fractures.[45,52-54] Similar outcomes have been achieved with suture button and screw fixation, but fixation with a suture button was associated with earlier return to work and less frequent implant removal.[49,50] In a prospective cohort study, Naqvi et al[46] compared the accuracy of reduction with suture button or screw fixation and found that suture button fixation was a more accurate method of syndesmotic stabilization. The authors used CT to assess reduction and found that 5 of 23 ankles (21.7%) treated with screw fixation were malreduced compared with no malreduced ankles in the suture button group, and no difference was found in the clinical outcomes of both groups. Several studies have suggested that syndesmotic malreduction is the most important independent predictor of clinical outcomes.[1,55] Suture buttons may play a role in optimizing reduction and mitigating the need for implant removal; however, an implant-

associated complication rate of 8% has been reported.[56] Modifications of the surgical technique and the development of a newer knotless suture button may reduce soft-tissue irritation related to prominent subcutaneous knots.

Authors' Preferred Management Method

Although no consensus exists on guidelines for the treatment of competitive athletes with syndesmotic injuries, our preferred approach is outlined in Figure 8.

Grade I and II Sprains

Because both clinical and plain radiographic criteria for the diagnosis of an unstable syndesmotic injury may not be reliable,[23] close patient follow-up is required to ensure that there is improvement in physical signs and symptoms. Obtaining follow-up full weight-bearing radiographs is also critical.

For stable grade I sprains with injury only to the AITFL and/or anterior deltoid, management involves immediate rest, ice, and immobilization in a non–weight-bearing cast or a removable boot for 3 to 5 days to allow the acute inflammation and swelling to subside. After this period, weight bearing is allowed as tolerated in a boot, and passive- and active-assisted motion is initiated with trainers or physical therapists, followed by resistance and proprioception. Once the athlete is pain free in the boot (typically, 7 to 10 days), he or she transitions to a stabilizing brace, and strengthening and functional exercises begin, followed by running and integration of sport-specific activities. The ability to repeatedly perform a single-leg hop is a reliable sign of healing. Integration of sport-specific activities is permitted when the athlete is able to do a single-leg hop 10 times without significant pain.

Management of grade II injuries varies. Athletes with a competent deltoid and PITFL without diastasis on radiography can typically be treated nonsurgically, with good results. Recovery time is about 2 to 3 times longer than that for a high-grade inversion sprain. For an elite athlete with a grade II injury and clinical or radiographic evidence of dynamic instability or injury to the PITFL and deltoid on MRI, we recommend a live fluoroscopic examination performed with the patient under anesthesia and, if necessary, arthroscopy to assess the syndesmosis and confirm the diagnosis (Figure 3). In our practice, syndesmotic widening >2 mm warrants fixation. This distance can be measured arthroscopically using a length-labeled probe. Alternatively, if a 3.5-mm arthroscopic small joint shaver fits into the syndesmosis, diastasis is confirmed (Figure 4). For grade II injuries in which (1) a more severe injury pattern is suspected based on MRI findings, but instability is not demonstrated on stress radiography, or (2) nonsurgical management has failed, minimally invasive fixation (eg, percutaneous placement of an implant) may be indicated to stabilize subtle syndesmotic instability. Rehabilitation for these cases can be more aggressive because they have inherent stability. Arthroscopy is a useful adjunct to detect and treat other potential sources of pain.

Grade III Ligamentous Injuries and Fractures With Syndesmotic Instability

In elite athletes, purely ligamentous grade III injuries in isolation are uncommon. These injuries more commonly occur with fractures or other injuries. The management approach is similar to that for fracture-associated syndesmotic instability. Screws, suture buttons, or a combination of the two can be used to stabilize the

Figure 8
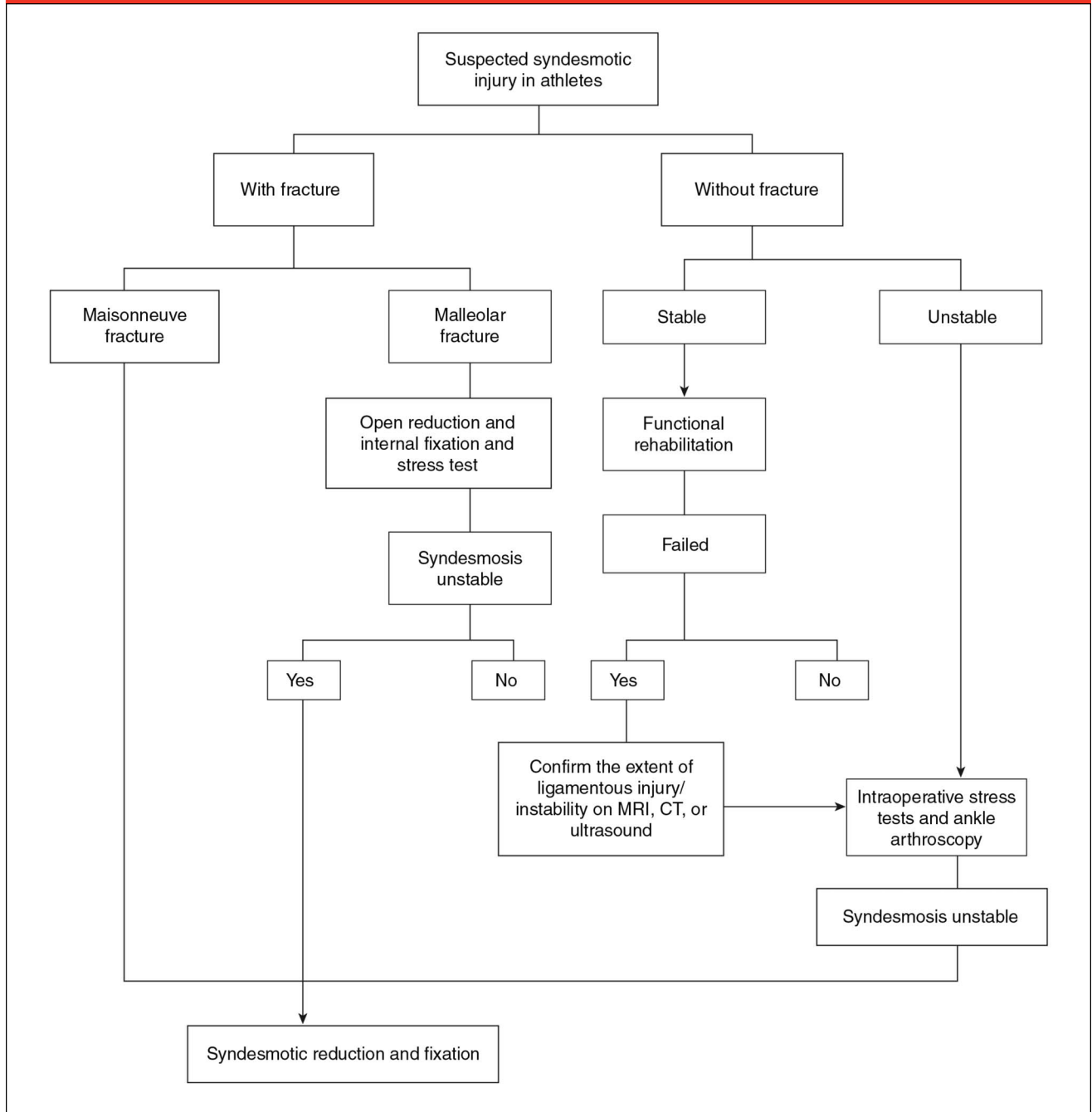
Treatment algorithm for suspected syndesmotic injury.

syndesmosis. When appropriate, we prefer to use suture button fixation after the other injuries have been addressed (Figure 7). One or two implants may be used based on the degree of instability and the size of the athlete.

The implant is inserted along the intermalleolar axis and parallel to the ankle joint. In elite athletes who require early return to high-impact activity, the use of a combination of buttress plating and a suture button construct may prevent a stress riser at

the drill holes. In athletes weighing >250 lbs, greater stresses are placed on the ankle mortise, and syndesmotic instability is managed using two 3.5-mm or 4.5-mm quadricortical screws as part of a neutralization technique performed with the ankle in a neutral

Figure 9

A   B
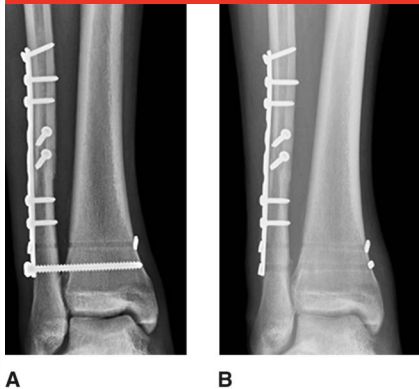
Postoperative AP radiographs of the ankle in a collegiate football player who sustained an injury to the syndesmosis. **A,** The patient was successfully treated with screw and suture-button construct. **B,** The screw was later removed and a suture button was placed.

Figure 10

Postoperative AP radiograph of the ankle in an elite soccer player treated for fracture-associated syndesmosis injury. After screw removal, the patient developed heterotopic ossification (arrow) but remained asymptomatic.

position at the time of fixation. Alternatively, a suture button can be used for initial reduction, and a 3.5- or 4.5-mm solid screw can be placed to stabilize the joint. The screw is removed after a minimum of 3 months and can be replaced with another suture button (Figure 9). More data are needed on clinical success rates and return to play characteristics associated with the use of a suture button, particularly in larger athletes.

We typically perform arthroscopy in the setting of syndesmotic stabilization to identify and address any concomitant intra-articular pathology and to confirm anatomic reduction of the syndesmosis.[24] Capsular tissue or deltoid fibers can often block the reduction at the medial gutter and can be removed or débrided arthroscopically. A primary open repair of the deltoid can be performed, although it tends to heal well with immobilization and anatomic reduction of the ankle.

Postoperative care begins with immobilization of the ankle in a splint or boot, with no weight bearing permitted for a period of 4 to 6 weeks. Range-of-motion exercises and resistance training should begin a few days after surgery, as tolerated by the patient. Progressive weight bearing in a boot and strengthening exercises can subsequently be introduced under close supervision. Patients can return to competitive sports at 10 to 12 weeks, depending on injury severity. We suggest that syndesmotic screw removal remain optional, but it is indicated if there is evidence of ankle stiffness associated with intact screws or if symptoms secondary to irritation are present. In the setting of planovalgus alignment, which can increase stress on the syndesmosis, the use of a suture button may be considered following screw removal to enhance stability (Figure 9).

Complications and Technical Considerations

Syndesmotic fixation can lead to complications, including the development of heterotopic ossification, implant failure, wound infection, and, most commonly, malreduction of the distal tibia and fibula.[57] Heterotopic ossification is a common, but rarely symptomatic, radiographic finding following syndesmotic injuries treated surgically and nonsurgically (Figure 10). Painful synostoses can be successfully treated with excision. Implant failure typically does not have a negative impact on syndesmotic function unless there is a recurrent diastasis of the syndesmosis, which warrants revision surgery. Mendelsohn et al[58] found that patients who were obese were 12 times more likely than nonobese patients to suffer a loss of reduction; diabetes mellitus, smoking status, and the type of construct used were not predictive of loss of reduction. Typically, healing occurs adequately in the first 3 to 4 months after surgery. Loose or broken screws observed after this period can be treated or removed if they are symptomatic. Wound infection is a potential complication associated with syndesmotic fixation, but it may also be related to the severity of the injury or the surgery performed to address associated fractures. Perioperative antibiotic prophylaxis should be used as a primary preventive measure.

Malreduction of the syndesmosis is associated with poor outcomes.[1,46,55] Miller et al[59] found that open reduction of the syndesmosis had a lower rate of malreduction diagnosed on CT than did closed reduction performed under fluoroscopy (16% versus 52%). Several techniques can be used to help avoid malreduction, including attempting to reproduce the normal osseous anatomy for fibular fixation,[27] placing clamps for syndesmotic reduction in the neutral intermalleolar axis to avoid anterior or posterior displacement of the distal fibula,[39] and placing screws or suture buttons in the neutral intermalleolar axis.

Overcompression of the syndesmosis remains a concern because it may alter the mechanics of the ankle joint and limit full dorsiflexion. No consensus exists regarding the position of the ankle at the time of fixation or the use of compression screws versus neutralization screws; equivocal studies exist to support and refute these methods.[60,61]

Compared with screw fixation, suture button fixation has been associated with fewer malreductions and lower rates of implant removal.[46,49] Reported complications associated with suture button fixation for ankle syndesmotic injury include knot prominence, entrapment of the tibialis anterior tendon, osteomyelitis, painful aseptic osteolysis, implant failure, ankle stiffness, heterotopic ossification, and unexplained pain. More evidence is required to determine rates of success and complications associated with this technique, particularly with newer implants.

Summary

Injuries to the syndesmosis are relatively common in certain athletic populations. Although many of these injuries can be treated nonsurgically, it is important to differentiate between stable and unstable injuries. Recent literature has improved our understanding of the sequence, severity, and significance of ligament disruption associated with injury to the syndesmosis, which has aided clinicians in determining treatment decisions and prognosis. Transsyndesmotic screw fixation remains a common and effective fixation method for syndesmotic injuries. No consensus exists regarding screw size, screw quantity, number of cortices, postoperative care, and the necessity of implant removal. In clinical and biomechanical studies, the suture button has shown promise as an alternative method for managing syndesmotic injuries. The key advantages of suture buttons include more physiologic motion, a significantly lower incidence of malreduction, and no need for routine implant removal.

References

Evidence-based Medicine: Levels of evidence are described in the table of contents. In this article, references 9, 17, 27, 31, 33, 37, 43, and 46 are level II studies. References 2, 50, 58, and 59 are level III studies. References 1, 7, 8, 10, 16, 18, 19, 23-25, 28, 30, 35, 44, 45, 49, and 52-57 are level IV studies.

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