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Syndesmosis injuries: acute, chronic, new techniques for failed management

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Disruption of the distal tibiofibular joint (DTFJ) or ankle syndesmosis occurs through an external rotation mechanism of injury. This is most commonly associated with Weber C, Lauge-Hansen pronation-external rotation fracture patterns or with Weber B, Lauge-Hansen supination-external rotation ankle fractures [1–5]. Syndesmotic disruption also can occur by way of the same mechanism with a Maisonneuve fracture pattern [6,7]. DTFJ can also result from severe or "high" ankle sprains that result in a purely ligamentous injury without an obvious fracture [8–12]. These isolated ligamentous injuries often do not result in gross disruption of the syndesmosis and can be difficult to diagnose.

A syndesmotic injury occurs through tearing, rupture, or bony avulsion of the syndesmotic ligament complex. The syndesmotic ligament complex consists of the anterior tibiofibular, the posterior tibiofibular, the transverse tibiofibular and the interosseous ligaments [13]. Without these ligamentous restraints the DTFJ widens and can result in an asymmetric ankle mortise. Many cadaveric studies have been performed to evaluate the force required and amount of DTFJ displacement with progressive sectioning of the syndesmotic ligaments.

Ogilvie-Harris et al evaluated the contributions of each of the syndesmotic ligaments to lateral displacement force [14]. The anterior tibiofibular ligament contributed 35%, the posterior tibiofibular ligament 40%, and the interosseous ligament 22%. They concluded that injuring just two of the three syndesmotic ligaments would decrease the DTFJ resistance to lateral displacement by half and predispose to DTFJ instability. Xenos et al simulated an external rotation injury pattern with progressive DTFJ ligament sectioning to produce syndesmotic

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instability [15]. They quantitated the amount of diastasis produced with radiographs and found that a complete disruption of all DTFJ ligaments resulted in an average diastasis of 7.3 mm. Sectioning of the interosseous ligament alone caused a 0.5-mm diastasis with each 2-cm segment. Sectioning of the anterior tibiofibular ligament resulted in a 2.3 mm increase and the posterior tibiofibular ligament an additional 2.8 mm increase in syndesmotic diastasis.

DTFJ diastasis results in an asymmetric mortise that causes alterations in the contact forces at the ankle joint. Burns et al assessed tibiotalar contact area and peak pressure with progressive diastasis after sequential syndesmotic ligament sectioning [16]. Deltoid ligament strain was found to increase with progressive sectioning of the DTFJ ligaments. Deltoid ligament transection resulted in a diastasis of 0.73 mm that translated to a 39% reduction in the tibiotalar contact area and a 42% increase in peak pressure. Decreases in contact forces increase joint pressures and can predispose to premature cartilage wear and arthrosis.

The diagnosis of DTFJ disruption can be difficult whether acute or chronic in nature. A variety of radiographic techniques have been described to evaluate the integrity or stability of the DTFJ. Specific criteria based on anatomic and clinical studies have been established and may be useful in identifying DTFJ disruption [17–19]. The most commonly used of these are the tibiofibular clear space (TCS) and the tibiofibular overlap (TFO) (Fig. 1). Harper and Keller defined the use of these measurements in a cadaver study [19]. Specimens without syndesmotic injury consistently displayed a TFO greater than 6 mm on the AP view and a TCS of less than 6 mm on AP or mortise radiographs. The most sensitive indicator of

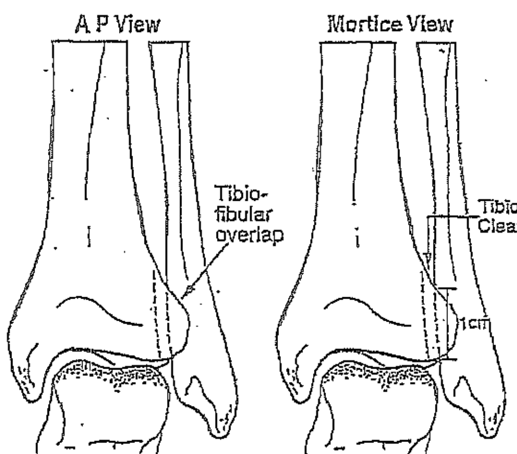

Fig. 1. The most commonly used method to assess for syndesmotic injury with diastasis of the DTFJ is through the measurement of the TFO and the TCS on weightbearing radiographs. These measurements should be taken at approximately 1 cm above the distal tibial joint line. The TFO is best measured using AP radiographs and the TCS using mortise radiographs.

DTFJ disruption and diastasis was a TCS of greater than 6 mm. Ebraheim et al in a similar cadaver study confirmed Harper and Keller's results regarding radiographic parameters [18]. They also performed a CT evaluation of the DTFJ disruptions for comparison. They found that a 1-mm diastasis cannot be detected reliably on either radiographs or CT scans because a TCS of 2.01 ± 0.49 mm is present normally. All 2-mm and 50% of 3-mm diastases were not detected on routine radiographs, however, but were apparent on the CT scans. They recommended the use of CT scans to help diagnose the subtle or occult DTFJ disruption when syndesmotic injury is suspected. Two studies on the late reconstruction of DTFJ disruption have also recommended the use of axial cut CT scans of the bilateral ankles to detect subtle syndesmotic diastasis when initial radiographs are not diagnostic (Fig. 2) [20,21].

Acute ligamentous injuries

The few studies describing the treatment of acute isolated syndesmotic ligamentous injuries focus on nonoperative treatment of these sprains because rarely is frank syndesmotic disruption seen. Taylor et al reviewed 44 football players with syndesmotic injuries [12]. All were treated nonoperatively because radiographs revealed no diastasis or fracture. With an average follow-up of 47 months, 23% of patients had chronic ankle pain, 36% complained of ankle stiffness, and 18% had persistent swelling. Eleven patients developed heterotopic ossification within the interosseous membrane after syndesmotic sprain. These patients had a slightly longer recovery time and were more prone to recurrent lateral ankle sprains. There was no significant difference between the groups with respect to ankle function, however, which was 86% good to excellent results. Hopkinson et al described the treatment of 15 acute syndesmotic injuries in military cadets, only one of which had radiographic diastasis [11]. Additional stress mortise radiographs were performed and revealed another case of syndes-

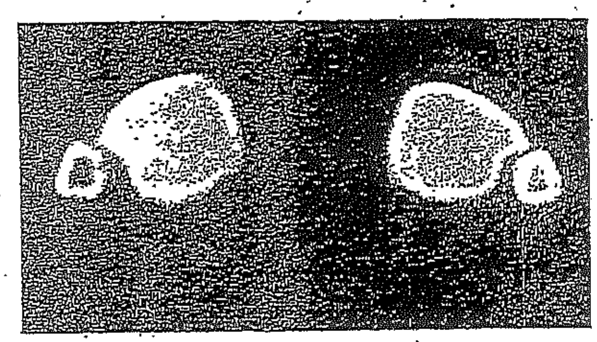

Fig. 2. CT scan of the bilateral ankles with DTFJ disruption. The TCS can be measured on the axial cuts as the distance between the posterior fibula incisure and the medial cortex of the fibula. The TCS will be increased in the side with the DTFJ disruption versus the contralateral extremity.

motic diastasis. These two patients were then treated with open reduction and internal fixation of the DTFJ. The remaining patients were diagnosed with syndesmotic sprains and displayed prolonged recovery time. At 20-month follow-up, asymptomatic heterotopic ossification of the interosseous ligament was noted in 9 patients, but no chronic ankle pain or loss of function was noted.

Edwards and DeLee described six cases of acute syndesmotic injury and diastasis treated operatively [9]. All cases underwent open reduction and internal fixation of the DTFJ with tibiofibular screw fixation and repair of the anterior tibiofibular ligament and the deltoid ligaments. There were no recurrences of diastasis after screw removal through follow-up. Fritschy reported 10 skiers with syndesmotic disruption [10]. Three were treated operatively with open reduction and tibiofibular screw fixation of the DTFJ. One patient treated nonoperatively had chronic ankle pain over the DTFJ. All patients treated operatively had complete relief of pain and return to function.

Unfortunately, the small size of these studies prevents us from drawing any definitive conclusions regarding the treatment of ligamentous syndesmotic injuries. They do suggest that a purely ligamentous syndesmotic injury without diastasis may be treated closed with activity modification with or without a short leg cast for up to 6 weeks. This should be followed by an aggressive physical therapy program involving strengthening, range of motion, and proprioceptive training allowing return to sports and regular activities as tolerated within 4 to 8 weeks. The patients should be counseled regarding the prolonged recovery time, the risk for heterotopic ossification of the syndesmosis, and the possibility of chronic ankle pain and swelling.

Acute ankle fractures with syndesmotic injuries

There have been an equally limited number of studies in the literature regarding the treatment of acute DTFJ disruption and syndesmotic diastasis in conjunction with ankle fractures. Leeds and Ehrlich reviewed 34 patients with bimalleolar and trimalleolar ankle fractures with disruption of the DTFJ [3]. After open reduction internal fracture fixation they found that the adequacy of the initial syndesmotic reduction had a marked effect on the incidence of final clinical results and ankle arthrosis. The quality of the initial DTFJ reduction was also directly related to the amount of diastasis or syndesmotic widening, referred to as late instability of the DTFJ, seen at 4-year follow-up. In turn, the stability of the syndesmosis at follow-up correlated with the incidence of good clinical results and slight to no ankle arthrosis in all 34 patients.

Using guidelines for syndesmotic fixation established by Boden et al in a biomechanical cadaver study, two other studies were able to more effectively recognize and treat syndesmotic injuries associated with ankle fractures [1,5,17]. Yamaguchi et al reviewed 21 Weber C ankle fractures [5]. After open reduction and internal fixation, only three patients required DTFJ reduction and fixation. At average follow-up of 3 years, no patient had late instability or syndesmotic

widening. Chissell and Jones reviewed 43 Weber C ankle fractures treated with open reduction and internal fixation [1]. Thirty-one of 43 patients underwent reduction and fixation of the DTFJ with a syndesmotic screw. Using the criteria of Boden, they found that 19 of the 31 patients had unnecessary use of a syndesmotic screw, because they achieved DTFJ stability through rigid internal fixation of the medial malleolar fracture. There was no difference in the functional results between the patients who had appropriate or inappropriate use of a syndesmotic screw for their DTFJ disruption. More importantly, 78% of those patients with satisfactory results had an anatomic reduction of the syndesmosis compared with 56% with unsatisfactory results. The mean increase in width of the DTFJ was less than 1.5 mm for all of the satisfactory results, suggesting that an increase of more than 1.5 mm in the syndesmotic width is an unacceptable reduction.

More recently, Ebraheim et al studied 32 Weber C ankle fractures with DTFJ disruption [2]. All patients were treated with open reduction internal fixation of the fractures with compression and reduction of the mortise, and a syndesmotic screw was used in 23 (72%) cases. Four fibular nonunions and two delayed unions were treated with bone grafting or hardware revision and eventually healed. Two patients with nonunions developed diastasis of the syndesmosis after removal of the syndesmotic screws at 9 weeks. At an average of 25 months follow-up, 72% had good results, 13% had fair results, and 16% had poor results. The poor results included three fibular nonunion cases. The most predictive criteria of clinical outcome were increased medial and tibiofibular clear spaces or malreduction of the mortise.

These studies confirm that obtaining and maintaining an anatomic reduction of the DTFJ in displaced ankle fractures associated with acute syndesmotic disruption reduces long-term disability and decreases the incidence of posttraumatic ankle arthrosis. This may be achieved through rigid internal fixation of the ankle fracture medially and laterally. Reduction and fixation of the DTFJ is indicated when remaining instability or diastasis persists after fracture fixation with a syndesmotic screw. Syndesmotic diastasis would be apparent if there was obvious radiographic widening of the mortise with a TCS greater than 6 mm or persistent lateral subluxation of the fibula. Syndesmotic instability may be detected using external rotation lateral stress radiographs to check for mortise widening. In addition, in cases without significant medial stability secondary to either fracture comminution or a medial malleolar fracture equivalent deltoid ligament rupture, particular care should be taken to determine the need for syndesmotic screw placement. Patients are usually treated with a nonweightbearing short leg cast during the time of fracture healing to prevent recurrent diastasis of the DTFJ for 6 to 8 weeks. Physical therapy may or may not be necessary for return to regular activities, depending on the patient. Return to regular activities or work without restrictions may take up to 4 to 8 weeks after fracture healing. Patients should again be counseled regarding the prolonged recovery time, the possibility of recurrent disruption of the DTFJ or chronic ankle pain and swelling, and the risk for posttraumatic arthritis of the ankle secondary to the fracture dislocation.

Syndesmotic screw removal should not be done before radiographic healing of the fibular fracture because fibular nonunion can lead to recurrence of the DTFJ disruption [2]. After fibular union occurs, syndesmotic screw removal time is variable and depends on the personal experience and preference of the surgeon. The studies available in the literature make no clear recommendations on the appropriate time to screw removal.

Syndesmotic screw placement

There are many methods of syndesmotic screw placement using various screw sizes and depths of cortical penetration with no particular consensus in the various clinical investigations. A full discussion regarding this topic is beyond the scope of the article. Numerous biomechanical cadaveric studies have been performed, however, to help us determine the best method of reduction and internal fixation of the mortise. McBryde et al performed a cadaveric study to analyze the appropriate level of placement of a syndesmotic screw [22]. They determined that a syndesmotic screw placed 2.0 cm proximal to the tibiotalar joint provided more DTFJ stability with a pronation external rotation force than one placed at 3.5 cm. Tornetta et al evaluated the need to place the ankle in dorsiflexion during syndesmotic screw placement to avoid over tightening of the mortise that would restrict ankle dorsiflexion [7,23]. They fixed the mortise with a 4.5-mm lag screw with the ankle in plantarflexion and found that there was no difference in ankle range of motion before and after syndesmotic compression. They concluded that it is the reduction of the mortise and not the degree of ankle dorsiflexion that is important in syndesmotic fixation.

The most commonly used method of syndesmotic fixation involves the use of one or two 3.5 or 4.5-mm fully threaded cortical screws angled anteriorly 20° to 30° from the fibula to the tibia [1–3,5,13,17]. The screws are tapped and not lagged to prevent over compression of the mortise, and engage either three or four cortices, depending on the preference of the surgeon. Thompson and Gesnick compared the use of a single 3.5 or 4.5-mm fully threaded cortical screw engaging three cortices for syndesmotic fixation [24]. They showed that there was no biomechanical advantage of a 4.5-mm versus a 3.5-mm screw in fixation of the mortise. Currently there is no biomechanical evidence to imply that one particular technique is superior to another. This author's personal preference is the use of two 4.5-mm fully threaded cortical screws, engaging four cortices, for syndesmotic fixation whenever possible. Of course, the patient's fibular size, fracture pattern, and degree of comminution, as well as fibular plate position (lateral versus posterior) may only allow the use of a single screw or substitution of 3.5-mm screws instead.

Chronic syndesmotic injuries

In the past, the treatment of chronic or late DTFJ disruption has been related to fibular malunion after Weber B or C ankle fractures [25–27]. Offierski et al

described shortening and external rotation of the fibula resulting in medial joint space widening, and talar shift that can result in syndesmotic widening and posttraumatic ankle arthrosis [25]. Eleven patients with Weber B or C ankle fractures with a fibular malunion and talar tilt with mortise widening were treated with a fibular osteotomy. The fibula was derotated and brought out to length using internal fixation. The mortise was fixed using a syndesmotic screw without repair of the DTFJ ligaments. At 4-year follow-up, four of seven patients with anatomically restored ankles had no evidence of arthritis. All four patients with residual talar tilt had arthritic changes of the ankle joint. Weber and Simpson reported the same procedure on a series of 23 cases with fibular malunion and mortise widening [26]. With an average follow-up of 11.2 years, 17 patients had excellent to good results. Six patients were graded as fair to poor with continued pain and all had progression of pre-existing ankle arthritis.

Yablon and Leach reviewed 26 patients with fibular malunions resulting in mortise widening and displacement of the talus [27]. These patients were also treated with a fibular lengthening and derotational osteotomy. They described the importance of debriding the DTFJ of scar tissue laterally and medially if necessary, to allow an anatomic reduction before placing the syndesmotic screw. They did not address or repair the syndesmotic ligaments. At an average of 7 years follow-up, 20 of the 26 patients were able to resume their preinjury level of activity, three were improved, and three had not benefited from the procedure. The three patients with a poor result had pre-existing ankle arthritis.

None of these studies found that the clinical results were dependent on the length of time from injury to surgery. The most predictive factor was the presence of ankle arthritis before surgical treatment. They concluded that in the presence of minimal to absent ankle arthrosis, corrective lengthening osteotomy of the fibula and reduction of the mortise with syndesmotic screw fixation can result in significant improvement in pain and function.

The late reconstruction of chronic DTFJ disruption without fibular malunion has been addressed by only a few investigators [20,21,28–30]. Outland described a type of DTFJ arthrodesis using bone graft through drill holes in the fibula and tibia in a syndesmotic screw fashion [29]. Mullins and Sallis treated acute and chronic DTFJ disruptions after ankle sprain with compression, reduction, and syndesmotic screw fixation [29]. Seventy-five patients underwent placement of a Johannsen lag screw across three cortices with good results. The syndesmotic screws were not removed. Beals and Manoli described a case report of a late reconstruction of the DTFJ using compression, reduction, and placement of one 6.5-mm cancellous screw with an excellent result [17].

More recently, Harper reported a series of six patients with Weber C ankle fractures, two treated with casting and four treated with open reduction and internal fixation [20]. Three of the four treated operatively also had placement of a syndesmotic screw. Two syndesmotic screws were placed 6 weeks and 18 months postfracture. All had chronic widening of the DTFJ with an average diastasis of 7.7 mm. Confirmation of the diastasis was documented using axial cut CT scans of the bilateral ankles. Open reduction and stabilization of the DTFJ was performed an average of 15 months post-fracture. Four patients required debridement of scar from the tibiofibular interval and two from the medial joint space. Syndesmotic screws used ranged from a single 4.5-mm cannulated screw engaging three cortices to one or two large 6.5 to 7.3-mm cannulated screws across four cortices. Partially threaded screws were always used to allow compression for reduction of the tibiofibular clear space. One patient underwent a DTFJ arthrodesis. At an average of 12 months follow-up, the clear space was reduced to normal (<6 mm) in all but one patient. The average AOFAS Ankle-Hindfoot Scale score was 91 postoperatively compared with 75 preoperatively. Four patients were completely satisfied, one satisfied with minor reservations related to continued pain and swelling, and one was dissatisfied with their surgical treatment.

Recently, Mosier-LaClair et al reported preliminary results on the late reconstruction of the DTFJ disruption with syndesmotic screw fixation and repair of the anterior distal tibiofibular ligament [21]. Eight patients with an undiagnosed DTFJ disruption and injury to the anterior distal tibiofibular ligament with chronic ankle pain and swelling over the DTFJ were identified. Five patients sustained a Weber C ankle fracture as their original injury and three patients sustained a severe ankle sprain. The mean time from injury to diagnosis and surgery was 4 years (range, 6 months to 25 years). All patients underwent bilateral standing anteroposterior, mortise, and lateral radiographs of the ankle preoperatively and postoperatively. The preoperative radiographs revealed obvious syndesmotic widening in five patients and posttraumatic ankle arthritis in one patient. In the other three patients, CT scans were obtained and confirmed syndesmotic widening. The AOFAS Ankle-Hindfoot Scale was used retrospectively preoperatively and postoperatively to assess clinical outcome and patient satisfaction.

All patients underwent ankle arthrotomy, with debridement of the syndesmosis, reduction of the DTFJ with internal fixation, and repair of the anterior distal tibiofibular ligament. Internal fixation of the syndesmosis was achieved by way of two fully threaded 4.5-mm cortical screws engaging all four cortices that were tapped as per standard AO technique. The ligament was repaired using two suture anchors. Medial debridement was not required to achieve anatomic reduction of the mortise. Intraoperative findings revealed scarring of the widened DTFJ for several centimeters proximal to the ankle joint and scarring of the anterior distal tibiofibular ligament in an elongated position. Postoperatively, patients were placed in a short leg nonweightbearing cast for 8 weeks. The syndesmotic screws were removed at an average of 12 weeks.

The mean preoperative AOFAS Ankle-Hindfoot score was 68 and the postoperative score 92 with a mean follow-up time of 2 years. Radiographic measurements postoperatively and at most recent follow-up have shown reduction of the DTFJ disruption and restoration of the ankle mortise when compared with the contralateral side. All patients had reduction of the DTFJ as measured by the TCS and TFO when compared with the contralateral extremity. Disruption of the DTFJ corresponded to an increased TCS and a decreased TFO on radiographic examination. With reduction of the DTFJ and reconstruction of the syndesmosis,

the TCS decreased and the TFO increased toward normal values for the unaffected extremity. The mean preoperative TCS was 6.4 mm compared with the mean postoperative TCS of 3.8 mm that compared favorably to the contralateral normal side at 3.9 mm. The mean preoperative TFO was 8.6 mm versus the mean postoperative TFO of 10.3 mm that compared favorably to the normal contralateral side at 11.1 mm.

No patient developed radiographic signs of arthritis postoperatively. The patient with pre-existing ankle arthrosis, however, did experience progression of his arthritis. The mean time to return to work or regular activities was 15 weeks. Seven patients returned to work or level of previous activity without restrictions and were satisfied with surgery with near to complete resolution of their symptoms. The patient with posttraumatic ankle arthritis did not return to work and was the only patient dissatisfied with surgery.

These two more recent studies, though small in size, are the most extensive available on the late reconstruction of DTFJ disruption or syndesmotic injuries [20,21]. Both studies emphasized the importance of debriding the DTFJ of scar laterally and the medial joint if necessary to obtain an anatomic reduction of the mortise before syndesmotic screw fixation. The importance of using a 4.5-mm or larger screw size engaging all four cortices was demonstrated in that the only recurrence of DTFJ disruption was in the one patient who underwent fixation with a single 4.5-mm screw engaging only three cortices [20]. Otherwise both studies displayed near equal clinical results with reduction and internal fixation of the mortise resulting in pain relief and return to functional activities. In Harper's study that did not address repair of the anterior distal tibiofibular ligament, however, there was one recurrence of DTFJ disruption, versus no recurrences in the latter study with repair of the ligament [20]. These results were independent of time from injury to surgery or patient age. Also, in the latter study there was no difference in outcome whether the patient's original injury was a high ankle sprain versus a Weber C ankle fracture [21]. The one predictive factor of a poor or less than satisfactory outcome in both cases was the presence of pre-existing ankle arthritis that led to continued chronic ankle pain and limitation in activities.

Operative procedure

The authors' preferred technique for the late reconstruction of syndesmotic injury or DTFJ disruption is as follows [21]. The patient is placed supine on the operating table with a bump underneath the ipsilateral buttocks. A padded pneumatic thigh tourniquet is placed on the affected lower extremity that is then prepped and draped in the usual sterile fashion. The limb is then exsanguinated with an Esmarch bandage and the tourniquet inflated to 295 mm Hg.

An anterolateral incision to the ankle is made directly over the DTFJ curving over the anterior fibula. The anterior tibiofibular ligament is then identified along with its tibial and fibular insertions. A capsulotomy is then performed at the distal aspect of the ligament to inspect the talar articular cartilage for any signs of arthrosis. The anterior tibiofibular ligament typically is found to be elongated and thickened with scar tissue throughout its length (Fig. 3).

The anterior tibiofibular ligament is then taken down from its tibial insertion in a subperiosteal fashion to expose the syndesmosis. The interosseous membrane in the distal syndesmosis is torn and replaced with scar tissue. There may also be osteophytes or heterotopic ossification present. The syndesmosis is then debrided from the DTFJ extending proximally, for the entire length of the scar tissue, until normal appearing tissue and interosseous membrane is seen. Insertion of a lamina spreader into the distal syndesmosis allows for complete exposure from anterior to posterior for adequate debridement.

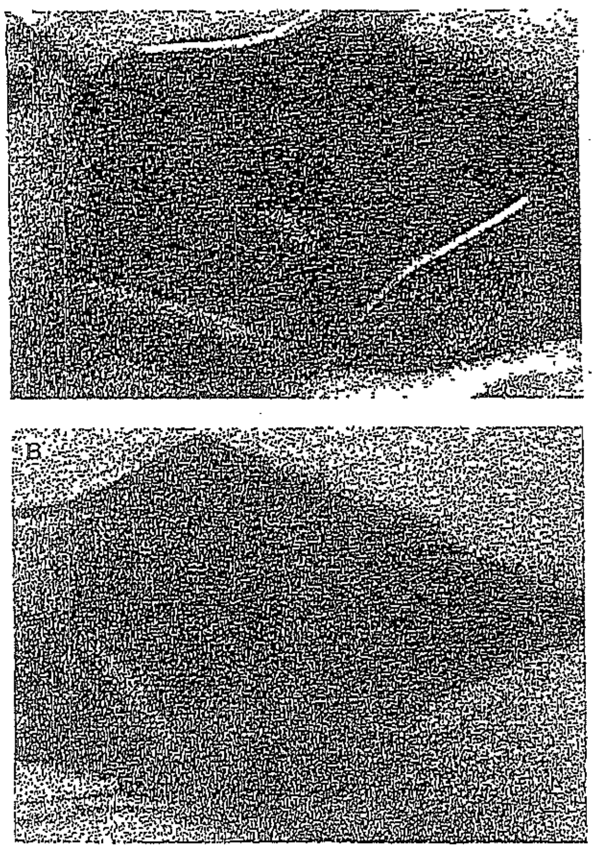

Fig. 3. Secondary to syndesmotic injury and chronic diastasis of the DTFJ, the anterior distal tibiofibular ligament becomes elongated and thickened with scar tissue.

A rongeur is then used to expose cancellous bone at the site of the tibial insertion of the anterior tibiofibular ligament. The drill for the Mainstay suture anchor system (2.7-mm suture anchors with O ethibond sutures) is then used to place the drill holes in the tibial insertion site, taking care not to violate the ankle joint. The suture anchors are advanced until flush with the tibial ligament insertion. A stab incision is then made in the skin overlying the medial malleolus and a large pointed reduction clamp is placed on the medial and lateral malleolus with the ankle in maximal dorsiflexion. The pointed reduction clamp is then used to reduce the DTFJ under direct visualization. The reduction of the syndesmosis is evaluated using the mini C-arm in the mortise view to ensure symmetry of the mortise and reduction of the DTFJ.

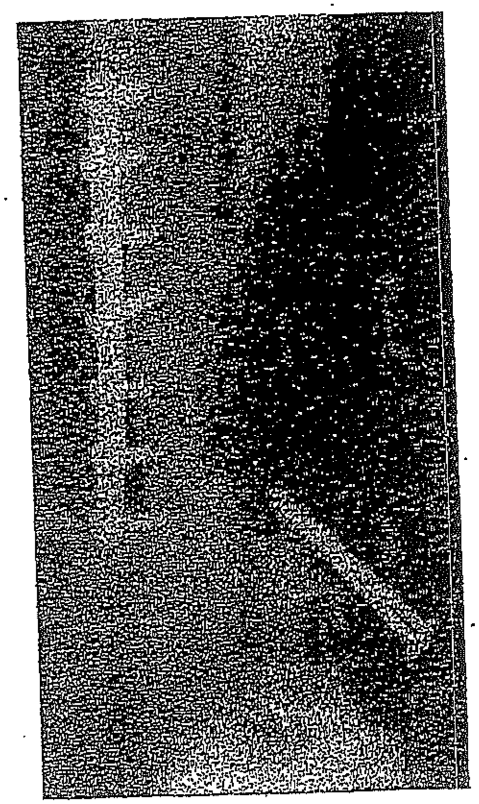

Fig. 4. Preoperative and postoperative mortise radiographs of the ankle with DTFJ disruption after open reduction and internal fixation of the syndesmosis with repair of the anterior tibiofibular ligament. (A) The TCS is measured on the mortise radiograph and is seen to be increased with DTFJ disruption. (B) Postoperatively the TCS is seen to be decreased on the mortise view compared with preoperative measurements.

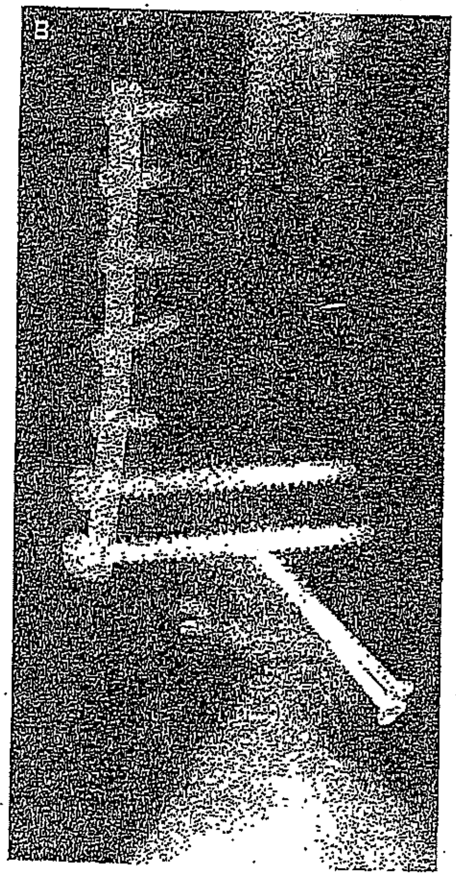

Fig. 4 (continued).

A separate incision is made over the lateral fibula approximately 2 cm above the tibial plafond. Two parallel 4.5-mm, fully threaded, cortical screws are placed in standard AO fashion from the fibula into the tibia, from lateral to medial, at a 15-degree angle across all four cortices. The pointed reduction clamp is removed and the mini C-arm again used to evaluate the reduction of the DTFJ and symmetry of the mortise (Fig. 4).

With the DTFJ reduced, the length and thickness of the anterior tibiofibular ligament is evaluated. The tibial stump should be debrided until just long enough to reach the tibial insertion. It is usually necessary to excise up to 3 to 5 mm from the tibial stump of the ligament to regain the appropriate ligament length. The ends of the sutures are then brought through the tibial stump of the anterior tibiofibular ligament and secured (Fig. 5). The wound is then closed and standard

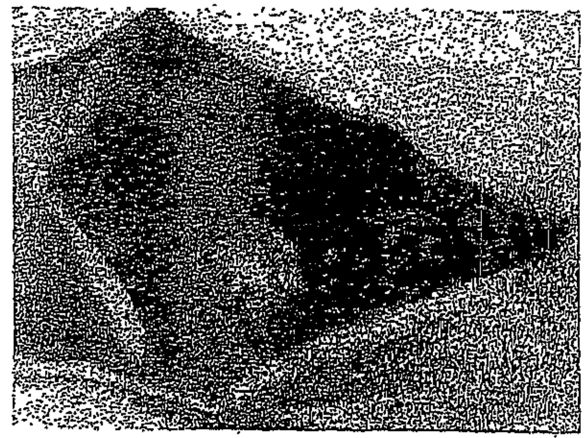

Fig. 5. After reduction and fixation of the mortise with syndesmotic screws, the anterior distal tibiofibular ligament is debrided to the appropriate length and reattached to its tibial insertion using suture anchors.

dressings, along with a Jones compressive dressing and posterior and U plaster splints, are applied with the ankle in neutral dorsiflexion.

Postoperative routine

Patients are evaluated 2 weeks after surgery with nonweightbearing mortise and lateral radiographs of the involved extremity. The skin staples are removed and a fiberglass nonweightbearing short leg cast is applied until eight weeks postoperatively. At that time, new nonweightbearing AP, mortise, and lateral radiographs of the involved extremity are obtained and the patient is allowed to weight-bear as tolerated.

At 12 weeks the patient is taken back to the operating room for removal of the syndesmotic screws. They are placed in a soft dressing and allowed to weight-bear as tolerated. They are reevaluated two weeks postoperatively and the skin staples removed. Activities are then advanced until full function and level of previous activity is achieved.

When disruption of the DTFJ occurs without obvious fracture it is difficult to diagnose and may be referred to as a high ankle sprain. Only a few studies have been published in the literature regarding this injury, its natural history, and treatment [8–12]. Rarely does radiographic examination reveal frank diastasis or syndesmotic widening associated with these injuries. Stress external rotation or mortise radiographs, however, may elucidate an occult DTFJ disruption not seen with initial examination. When diastasis occurs, open reduction and internal fixation of the syndesmosis is recommended, with or without repair of the anterior tibiofibular ligament. Though these few small studies do not establish clear guidelines for the treatment of a purely ligamentous syndesmotic injury without diastasis, they do recommend operative reduction of a syndesmotic injury with DTFJ disruption to reduce the incidence of chronic ankle pain and dysfunction.

Several retrospective clinical studies previously reviewed have evaluated the treatment of acute syndesmotic injury or DTFJ disruption in association with ankle fractures [1–3,5,7]. Though the indications for syndesmotic screw placement vary greatly, it is clear that frank diastasis not reduced by rigid internal fixation of medial and lateral malleolar fractures should be addressed appropriately with reduction of the DTFJ and internal fixation. Anatomic reduction of the DTFJ has been directly correlated with reduction in long-term morbidity and a decreased incidence of ankle arthrosis after ankle fracture [3].

All of the aforementioned studies have been related to the diagnosis and treatment of acute syndesmotic injuries with or without DTFJ disruption. Most studies related to treatment of chronic disruption of the syndesmosis have been secondary to fibular malunion after Weber B or C ankle fractures [24–26]. A few small studies and case reports have discussed the late reconstruction and failed reconstruction of syndesmotic injuries [20,21,27–29]. They have shown that the late reconstruction of chronic DTFJ disruption with reduction and internal fixation of the DTFJ with or without repair of the anterior tibiofibular ligament resulted in pain relief and significant improvement in clinical function. Patients achieved a good to excellent result with near to complete pain relief and return to full activities, and were satisfied with surgery as evidenced by an increase in the postoperative AOFAS Ankle-Hindfoot scores. Results were independent of patient age, original injury, and time from original injury to surgery. The only reported recurrence of DTFJ disruption after late reconstruction was after use of a screw engaging only three cortices; the patient did not undergo repair of the anterior distal tibiofibular ligament [20]. The only predictor of a poor outcome was the presence of pre-existing ankle arthrosis at the time of operative treatment. Though a reduction of the DTFJ was achieved, these patients did not obtain improvement in their symptoms. Therefore the presence of pre-existing ankle arthrosis is a relative contraindication to performing a DTFJ reconstructive procedure because it is unlikely to result in relief of pain or improvement in function.

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