CHAPTER **26**

# THE SUBTALAR JOINT SPRAIN

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Inversion injuries to the lateral ligamentous complex of the ankle joint have been studied extensively, and are readily recognized by physicians treating disorders of the foot and ankle. Subtalar joint sprains, on the other hand, have been the subject of few studies, and are a little-known and frequently undiagnosed clinical entity. It is only over the last ten years that there has been any serious interest in instability of the subtalar joint as a result of the "inversion ankle sprain." Some orthopaedic literature has suggested the diagnosis of subtalar joint instability as a distinct clinical entity only after failure to achieve a "stable ankle" following surgical reconstruction of the lateral ligamentous complex for ankle instability. Subtalar joint instability is estimated to occur in 10% to 25% percent of all patients exhibiting lateral ankle instability.

The author has examined patients over the last several years who reportedly sustained a typical ankle sprain injury. These patients exhibited a significant post-traumatic sequelae of chronic pain, instability or stiffness, and significant limitation of normal activities, including daily living. Upon further clinical investigation and radiographic and imaging studies, the author has learned that the problem involves injury to the subtalar joint complex rather than the ankle joint. As a result of these experiences, the author has been reviewing the literature to gain a better understanding of injuries of the subtalar joint which are not of the obvious subtalar joint dislocation type. It is hoped that this paper will increase the reader's awareness that subtalar joint sprain injuries are a distinct clinical entity which can be quite disabling.

## LITERATURE REVIEW

Although there have been numerous articles dealing with anatomic and cadaveric studies of the ligaments stabilizing the ankle joint complex and the resultant effects of their loss, there have been very few articles dealing specifically with the subtalar joint sprain as a distinct clinical entity. Rubin and Witten are credited as being the first authors to suggest a clinical significance to subtalar joint instability and propose a method to study the instability.[1] They calculated the tibiocalcaneal angle using a foot stabilizing device and stress tomograms. None of the 27 patients studied, (including 17 with symptoms of "excessive turning over") had obvious subtalar instability.

Christman and Snook, in a 1969 article describing a modified Elmslie procedure for lateral ankle instability, recognized subtalar joint instability at the time of surgery in three of their seven patients.[2] Morbidity of the Christman-Snook Procedure has been studied critically by Horstman et al. as well as Snook et al.[3,4] It has led some authors to seek other procedures which are more biomechanically and anatomically sound for reconstruction of the calcaneofibular ligament which is believed to be a key ligament stabilizing the subtalar joint complex.[3,5]

In 1977, Brantigan et al. used the methods of Rubin and Witten to study and demonstrate subtalar instability in three patients.[6] They suggested a normal tibiocalcaneal angle of 38 ± 6 degrees. In their three patients the angles were 53, 62, and 55 degrees. They advocated the technique of evaluation because they wanted to demonstrate that the Watson-Jones procedure, which was popular at the time, failed to reconstruct functional stabilization of the subtalar joint by the calcaneofibular ligament.

Other authors have implied that subtalar joint instability exists, and that it may persist in spite of ligamentous repair of one of more of the lateral collateral ligaments of the ankle. Some have suggested it may be a separate and distinct clinical entity that has not received sufficient study.

## ANATOMIC CONSIDERATIONS

The subtalar joint is stabilized by a number of different ligaments and periarticular structures of varying importance. These include the calcaneofibular ligament and talocalcaneal ligaments laterally; the cervical ligament and interosseous

ligaments centrally within the sinus tarsi region; and the deltoid and talocalcaneal ligaments medially. In addition, the extensor retinaculum has also been suggested as a somewhat less significant stabilizing force to the subtalar joint.

The importance of each of these structures in stabilization of the subtalar joint varies. Most authors agree that the calcaneofibular ligament is the most important structure, followed by the ligaments of the sinus tarsi. Several experimental cadaveric studies support this contention.[7-10] Information from these studies has provided insight into the mechanism of ankle inversion sprains and subtalar joint instability. The ability to apply this information in the clinical setting and provide an effective, simple, cost-effective method to document subtalar instability has been the ongoing challenge.

The lateral tendinous structures also provide functional stability to the subtalar joint complex. They are influenced by the architectural configuration of the subtalar joint complex itself and other structural abnormalities such as a calcaneal varus or ankle varus deformity. Foot and ankle specialists recognize the importance of various foot types such as the cavovarus deformity which might predispose a patient to ankle joint instability.

## MECHANISM OF INJURY

Frontal plane inversion is the primary mechanism by which varying degrees of ligamentous injuries occur to the ankle joint. Most authors agree that the degree of dorsiflexion or plantarflexion will have an influence on the extent and degree of disruption the ligament sustains. If the ankle is in plantarflexion, then increased strain is placed on the anterior talofibular ligament while simultaneous dorsiflexion increases the strain on the calcaneofibular ligament.

Inversion forces are also the primary mechanism and force responsible for medial subtalar joint dislocations. Plantarflexion is also thought to be a common component. Although the calcaneofibular ligament is universally ruptured with medial subtalar dislocations, the soft tissue injury pattern is distinctly different from those of lateral ankle ligamentous disruptions. In medial subtalar dislocations, there is complete rupture of the talonavicular joint capsule as well as the talocalcaneal ligaments and joint capsule, in addition to the calcaneofibular ligament. If the force continues, there is complete tearing of the ligaments within the sinus tarsi as well as the deltoid ligament, resulting in complete dislocation of the talus. The subtalar joint sprain occurs somewhere on the continuum between these two entities. Most authors agree that there must be a significant inversion force. Most believe that a component of dorsiflexion is also present, increasing the strain on the calcaneofibular ligament with resultant rupture. The anterior talofibular ligament may or may not be ruptured.

Experimental investigations on cadaveric specimens and radiographic studies strongly support the calcaneofibular ligament as the primary stabilizer of the subtalar joint.[7-12] Transection of the ligament results in increased instability of the subtalar joint. The contribution of the interosseous talocalcaneal ligament to stabilization of the subtalar joint is more controversial. Because of its anatomic location with respect to the talus and calcaneus, as well as its relationship to the subtlalar joint axis, some authors believe its role is more questionable.[13-15] Others have suggested, based on cadaveric studies, that transection of the ligaments within the sinus tarsus is followed by a measurable increase in subtalar joint mobility and instability.[8,9,11]

In spite of the agreement regarding the role and function of the various soft tissue structures, most notably the ligaments, the reader is left with several unanswered questions regarding this entity. If a patient sustains a traumatic rupture of the calcaneofibular ligament, what determines if he or she will suffer from chronic ankle instability, subtalar joint instability or both? Why do some individuals with known ankle instability and complete ruptures of the calcaneofibular ligament never complain of subtalar joint problems? What role does the foot-type itself have to do with ankle and subtalar joint instability? Does dysfunction of the peroneal tendons, especially the peroneus brevis, contribute to ankle and subtalar joint instability? Perhaps the lateral talocalcaneal ligaments and joint capsule, as well as the ligaments of the sinus tarsi complex, play a more important role than is presently suggested.

## DIAGNOSIS

A subtalar joint sprain should be suspected whenever a patient presents with symptoms associated with a history of an acute or chronic injury to the ankle joint. Although instability is most commonly

reported, the author's experience is that pain around the ankle joint may be the more prominent and striking feature. Instability may or may not be present, and in some cases stiffness may be the major complaint along with the pain. In each of the four cases encountered by the author, the patients complained more of pain with attempted movement of the ankle or subtalar joint. Each patient, however, clearly reported an inversion-type injury to the affected foot/ankle with the exception of one patient who described an eversion type of injury.

Physical examination reveals pain and tenderness to manipulation of the subtalar joint complex. This is particularly noticeable with attempted anterior dislocation of the calcaneus on the talus, or inversion of the subtalar joint. There is pain to palpation of the lateral ankle and subtalar joint complexes, as well as pain to palpation of the sinus tarsi area. An injection of a short- or long-acting anesthetic into the sinus tarsi or posterior subtalar joint usually provides temporary relief. Mobility of the joint may be increased during this time period. Once the local anesthetic wears off, symptoms usually return.

Conventional weight-bearing radiographs may or may not prove to be beneficial. If significant mobility is present, there may be evidence of malposition between the talus, calcaneus and navicular as was seen in two of the four patients diagnosed and treated by the author (Figs. 1A-1D). In other cases, the conventional radiographs may appear to be normal with respect to the architecture of the individual bones and alignment of the

Figure 1A. Weight-bearing dorsoplantar (left) and neutral position dorsoplantar (right) x-rays of a 14-year-old male who sustained a severe twisting injury to the foot and ankle when he fell down a flight of stairs. Notice the severe peritalar subluxation. Clinically, the subtalar and midtarsal joints were grossly unstable and painful to manipulation.

Figure 1B. Weight-bearing dorsoplantar x-ray of the right foot. Notice normal alignment of the peritalar joints. The patient indicates that the two feet were identical prior to injury.

Figure 1C. Weight-bearing lateral x-ray of the left foot.

Figure 1D. Weight-bearing lateral x-ray of the asymptomatic right foot. Notice the difference in alignment between the two feet.

subtalar and midtarsal joints. A careful search should be undertaken to identify small avulsion or chip fractures which would suggest ligamentous injury. Subtle malalignment of the subtalar joint may be present. In all cases, ankle joint views should be obtained to rule out primary ankle pathology. In each of the author's four cases, the ankle joint films were unremarkable, with the exception of one patient who had a previous open reduction internal fixation for a pronation-external rotation fracture-dislocation of the ankle joint.

### Special Radiographic Studies

Several radiographic imaging studies have been suggested to further investigate subtalar joint sprains, and more importantly subtalar joint instability, which is believed to be the usual sequelae of the sprain. The challenge has been to identify a practical, cost-effective, easily-reproducible study to confirm subtalar joint instability. The author, however, does not feel that emphasis necessarily needs to be placed on assessing instability unless this is the primary patient complaint. Conventional, readily-available, cost-effective studies already exist which may be very helpful in confirming that the subtalar joint is the primary source of the patient's pain as a result of the sprain injury even in the absence of a complaint of instability.

Ankle stress views may demonstrate subtalar joint instability provided there is adequate penetration of the x-ray and the subtalar joint is not obscured by the evaluator's lead gloves, the placement of the extremity on the film or an overlying grid.[5] Obvious anterior translation of the calcaneus beneath the talus on the anterior drawer test and/or opening of the posterior subtalar joint on the inversion stress test both suggest subtalar joint instability.

Several authors have suggested using subtalar stress radiographs to assess instability.[5,9,10,16] This radiograph is a 40 degree Broden x-ray view with simultaneous inversion stress to the subtalar joint. Loss of parallelism between the adjacent surfaces of the posterior facet is suggestive of subtalar joint instability.

Stress tomograms have also been used but have met with varying degrees of success.[1,6] Special devices have been devised, and the relationship of the calcaneus to the tibia studied. The results have been questionable. Clanton suggested that loss of congruity of the subtalar joint on conventional CT scan would be a clear indication of subtalar joint instability.[5] The author agrees with this concept. In one case of the author, the conventional CT scans were interpreted as being normal by the radiologist, however, the author believes that the scan clearly demonstrated a loss of subtalar joint congruity on multiple sections (Fig. 2).

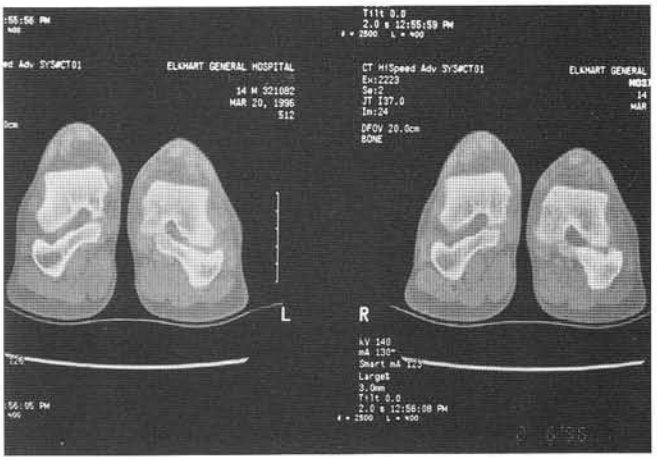


Figure 2. CT scan of patient shown in Figure 1. Notice the malalignment of the subtalar joint on the affected side. There is a loss of joint congruency which correlated with the clinical observations and other radiographic findings. This patient was subsequently diagnosed with Ehlers-Danlos Syndrome which may have contributed to his problem.

Subtalar joint arthrography has also been used to evaluate subtalar joint instability.[5,12] Meyer found ruptures involving the capsulo-ligamentous structures of both the ankle and subtalar joints in thirty-two of forty patients studied by this means. Six patients demonstrated positive arthrograms with negative ankle stress films. Clanton suggests combining this study with stress films of the ankle and then correlating the results to determine the optimal treatment, but, cautions that the arthrogram should be used on a limited basis until further studies confirm its usefulness.[5] Presently, arthrography is considered an additional investigative study which is invasive in nature and therefore has potential for added morbidity.

The author has found the limited extremity conventional bone scan to be a valuable tool in evaluating patients with chronic pain in the subtalar joint following an inversion sprain injury. In two cases where significant pain and limitation of motion were present, the bone scan demonstrated significant uptake within the subtalar joint in the absence of any significant findings on

conventional x-rays (Figs 3A, 3B). The clinical findings suggested early post-traumatic arthritis although the x-rays showed no obvious pathology. The bone scan results seemed to confirm the clinical observations. The results of the bone scan provided convincing evidence that the pathology was indeed within the subtalar joint and not the ankle joint as might have been expected (Figs. 4A-4C).

Figure 3A. Conventional bone scan of a 38-year-old male who sustained an inversion ankle sprain injury. He has severe pain and limitation to motion preventing him from performing his job duties and activities of daily living. The pattern of uptake strongly suggests involvement of the subtalar joint. He had no prior history of a foot problem.

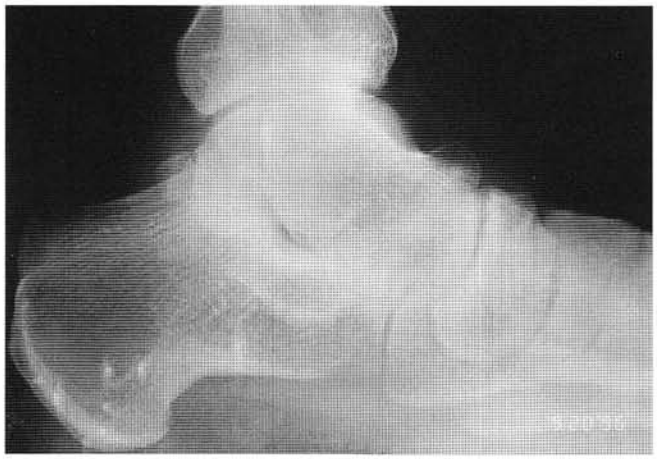

Figure 3B. Lateral x-ray of the same patient. Notice the normal appearance of the subtalar joint in spite of the abnormal bone scan. The CT scan was also normal.

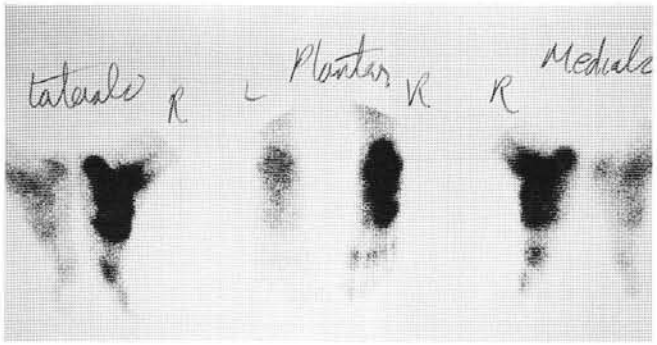

Figure 4A. Conventional bone scan of a 24-year-old male who sustained an ankle sprain injury. The pattern of uptake strongly suggests involvement of the subtalar joint and midtarsal joint complexes. The patient was managed conservatively and made a complete functional recovery without any surgical intervention. He suffered from clubfoot deformity in childhood and was treated for the same. He has not had symptomatology or required treatment of his feet since childhood, until this injury.

Figure 4B. Lateral x-ray of the same patient. Notice the early changes in the subtalar joint consistent with the history and injury. The changes are also consistent with the bone scan.

Figure 4C. The lateral x-ray of the opposite extremity. Notice the normal appearance of the joint and the differences when compared to the affected side.

Magnetic Resonance Imaging (MRI) has been used extensively to study the ligamentous injuries of the ankle. It is common today to employ MRI to study the status of the ligaments of the lateral aspect of the ankle to determine the presence and extent of injury. This sophisticated modality is capable of imaging the subtalar joint and the sinus tarsi as well. Sinus tarsi syndrome, a possible sequelae of an ankle or subtalar joint sprain, is readily identified on MRI films by a skilled radiologist. A primary problem with the use of MRI for the evaluation of the sinus tarsi area is the inconsistency in technique, and the inability to obtain meaningful and accurate interpretations by a radiologist. As the cost decreases and the number of skilled musculoskeletal radiologists able to provide an accurate interpretation increases, the use of MRI is likely to increase dramatically. MRI is capable of providing the most detailed information of the capsulo-ligamentous tissues as well as bone.

## TREATMENT

The choice of treatment of the acute subtalar joint sprain is not clear. It would seem logical that most acute cases should be managed similar to that of an acute ligamentous injury to the ankle joint with temporary immobilization, followed by aggressive physical therapy and rehabilitation. NSAID therapy may also be necessary, depending on the degree of inflammation and persistence of symptoms. One or more injections of the posterior subtalar joint, or more commonly the sinus tarsi area, may be necessary in some cases. Orthotic devices, ankle bracing and/or a lateral heel wedge may also be necessary to provide stability and limit excessive subtalar joint motion.

Chronic instability may require surgical intervention to stabilize the subtalar joint and the ankle joint as well. Theoretically, a delayed primary repair of the calcaneofibular ligament, alone or in combination with repair of the anterior talofibular ligament should resolve the instability. In other cases, a secondary ankle stabilization procedure which recreates the calcaneofibular ligament should be sufficient.

Specific procedures for the lateral ankle and subtalar joint instability have been described. These procedures consist of tendon transfers involving the distal portion of the peroneus brevis tendon and are modifications of the Christman-Snook Elmslie procedure.[16,18,19] Others have suggested using the plantaris tendon or a portion of the tendoachilles. Specific reconstruction of the interosseous talocalcaneal ligaments, if performed, should be done to prevent separation of the talus and the calcaneus, and restrict anterior displacement of the calcaneus on the talus. Tightening of the inferior extensor retinaculum has also been described.[20]

If pain and stiffness are the primary complaints, then a different approach to the problem should be undertaken. This is also true of cases in which the instability is in the direction of pronation (lateral displacement of the calcaneus, rather than medial displacement). Cases of lateral instability may be associated with symptoms similar to that of a patient with tibialis posterior dysfunction and/or a collapsing pes valgo planus deformity. Subtalar joint arthroereisis or arthrodesis may prove very efficacious for treating this subgroup of patients.

The author has used subtalar joint arthrodesis not only for cases of lateral subtalar joint instability or subluxation, but also for cases involving chronic pain and stiffness (Fig. 5). The short term clinical and radiographic outcomes have been excellent, with the exception of one case which initially did well but subsequently developed a chronic pain syndrome of unknown etiology. At the time of this writing, the patient continues to receive ongoing evaluation to determine the cause of his symptoms.

Figure 5. Postoperative dorsoplantar and lateral x-rays of the patient in Figure 1 following subtalar joint arthrodesis to establish realignment and stability to the rearfoot. The midtarsal joint has been asymptomatic. Notice the excellent alignment of the subtalar and midtarsal joint complexes. The intent at the time of surgery was to match the affected extremity to the opposite extremity, as existed prior to the injury. One year following surgery, he has a full functional recovery without complications.

## SUMMARY

Subtalar sprains are a distinct clinical entity which occur by the same mechanism as the typical inversion ankle sprain. The usual sequelae is instability of the subtalar joint which can be confirmed by a number of different studies. Pain and stiffness, or lateral peritalar subluxation with a resultant collapsing pes valgo planus deformity may also be seen.

Successful treatment depends upon establishing the proper diagnosis. If conservative treatment modalities do not control symptoms, then surgical intervention is indicated. The surgical procedure selected will depend upon the patient's symptoms and the specific goals to be achieved. Possible procedures are delayed primary repair of the lateral collateral ligaments of the ankle and/or the subtalar joint, secondary repair employing any number of tendinous structures, as well as arthroereisis or arthrodesis of the subtalar joint complex.

Because the entity has not been well-described or studied, a high index of suspicion is necessary to recognize the disorder and render an accurate diagnosis and proper treatment. It is hoped that this paper will increase the physician's awareness of this potentially disabling clinical entity.

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