CHAPTER **18**

THE USE OF TRANSSYNDESMOTIC SCREWS IN WEBER B ANKLE FRACTURES

Aimee A. Nichols, DPM

The Lauge-Hansen and the Danis-Weber AO systems are the most popular methods for describing and classifying ankle fractures. A Danis-Weber Type A fracture is described as one occuring below the level of the ankle syndesmosis. Type B is a fracture beginning at the level of the syndesmosis and Type C is a fracture above the level of the syndesmosis. A Weber B, or Lauge-Hansen supination external rotation injury is the most common type of ankle fracture treated. These are described as low fibular fractures that are spiral in nature originating at the level of the ankle syndesmosis. The syndesmosis is comprised of the anterior and posterior inferior tibio-fibular ligaments, the interosseous ligament and the transverse tibiofibular ligament. The pathology and the order that it occurs with these fractures is as follows: disruption of the anterior inferior tibiofibular ligament, a spiral fracture of the fibula beginning at the joint line and extending posterior and inferior, disruption of the posterior tibiofibular ligament or fracture of the posterior malleolous and medial injury consisting of malleolar fracture or deltoid ligament rupture. Diastasis of the ankle joint typically occurs when trauma to the interosseous ligament occurs. Weber B fractures usually are not accompanied by interosseous ligament damage or resultant tibiofibular diastasis but it is possible. Work done by Cedell in 1967 and Colton in 1968 demonstrated that diastasis with low fibular fractures does occur. When this syndesmotic injury occurs, it adds a degree of instability to the ankle joint that is not repaired with the fixation of the fracture alone. Additional measures of syndysmotic stabilization are required to correct the pathology.

The most popular use for transsyndesmotic screw fixation is in the case of pronation-external rotation injuries in which the level of the fibular fracture originates proximal to the ankle syndesmosis. These fractures are thought to injure the syndesmosis up to the level of the fracture. This situation creates instability and malalignment of the ankle joint and potential for post-traumatic arthritis. The goal of surgical management of this type of fracture is to stabilize the syndesmosis until healing has occurred with the use of a transsyndesmotic screw. Colton, in a 1968 study, looked at 7 patients with oblique fibular fractures that were associated with diastasis of the inferior tibiofibular joint. Four of these had associated medial malleolar fractures and three had deltoid ligament damage. Colton concluded that accurate assessment of the inferior tibiofibular diastasis could only be made once the fracture was surgically exposed. He stated that fixation of the fibular fracture alone would leave the diastasis of the tibiofibular articulation untreated and instability of the ankle joint would persist. Therefore syndesmotic screw fixation was recommended. However, in a 1989 study, Boden et al used cadavers to demonstrate that Weber Type C injuries along with a deltoid rupture medially did not require a transsyndesmotic screw for fixation unless the fibular fracture was 3 to 4.5 cm above the tibiotalar joint. In this study, a mortise ankle view was used to measure the syndesmotic width that would only detect an overt diastasis. This method of testing does not take into consideration the accuracy of radiographic angulation. In addition, no stress views were obtained preoperatively or intra-operatively that would demonstrate an occult diastasis with instability. Ebraheim et al reviewed 7 patients with Weber B fibular fractures that were associated with deltoid ligament injury and diastasis of the inferior ankle joint. Axial CT scans were performed bilaterally to compare injured and non-injured ankles. They found that syndesmotic disruption was easily seen on CT examination and in 3 patients, anterior fibular subluxation was present that was not seen on pre-operative radiographs. It was also found that the incisura fibularis in injured patients was shallow measuring only 2.7 mm (with normal being 4 mm). They suggested that factors that may need to be considered for the application of a transsyndesmotic screw are depth of the incisura fibularis, posterior malleolar fracture, deltoid ligament injury and occult fibular subluxation.

Intra-operative stress testing plays a key role in the assessment of tibiofibular diastasis injuries. These should be performed before and after the syndesmotic fixation is placed. The stress tests consist of a lateral force applied to the fibula via a hook, and observing the lateral fibular displacement. This attempts to displace the fibula from the ankle mortise that would indicate sydesmotic instability. The Cotton test is performed by grasping the foot at the talar level medially and laterally with the thumb and forefinger of one hand and stabilizing the distal leg with the other hand. A mediolateral force is applied and instability and crepitus are assessed from the degree of mortise widening. If either or both of these tests are positive, a transsyndesmotic screw must be considered for stabilization.

The transsyndesmotic screw(s) is placed from the fibula medially into the tibia and engages three or four cortices. The screw ideally should be 4.5 mm in size and is placed 2-3 cm from and parallel to the tibiotalar joint. This screw may be placed through the distal hole of the fibular plate if one is used. McBryde et al utilizing 17 cadaver legs, studied the amount of widening of the ankle syndesmosis when a 150 lb force was placed on the limb with the syndesmosis unfixated and fixated at 2 cm and 3.5 cm above the ankle mortise. They found that there was less syndesmotic widening with the transsyndesmotic screw placed at 2 cm above the tibiotalar joint. The screw should be angled 25-30 degrees from posterolaterally on the fibula and aiming anteromedially on the tibia as the fibula sits posterior to the tibia. The foot should be held in maximum dorsiflexion while the screw is placed to ensure that the widest portion of the talus is within the mortise at the time of fixation. This prevents sagittal plane motion limitation of the ankle.

The transsyndesmotic screw is typically removed 8-10 weeks after the initial open reduction of the ankle injury. The screw prevents normal tibio-fibular translational movement and is removed to allow this motion for return to full weight-bearing activities. Some authors advocate the use of bioabsorbable fixation for transsyndesmotic stabilization. These biomaterials lose their shear strength over time and slowly are absorbed by the body therefore eliminating the need for secondary surgery for screw removal. Sinisaari et al evaluated 18 patients with bioabsorbable syndesmotic screws and 12 patients with metallic screws 12 months after surgery. Measurements were taken from radiographs and CT scans and range of motion and sick leave duration were considered. They found there was no statistical differences noted between the two groups in any category.

CASE REPORT

A 43-year-old obese female with a history of right ankle injury sustained from a fall while walking was brought to the emergency room by ambulance. She related a "snap-pop" sensation at the time of injury. The patient was seen by an emergency room physician and ankle radiographs were taken. The patient was diagnosed by the physician as having a spiral oblique fracture of the right fibula, placed in a posterior splint and sent for podiatry outpatient follow up.

The patient presented to the podiatrist's office 11 days post injury where she was diagnosed with an supination external rotation 4 ankle fracture. The fibula was shortened by 3-4 mm and posteriorly displaced by 3 mm (Figures 1, 2). There was comminution present at

Figure 1. AP radiograph demonstrating medial clear space widening and lateral talar displacement within the ankle mortise. The tibial-fibular overlap is 1 mm and the tib-fib clear space is increased to 5 mm.

Figure 2. Mortise ankle view showing spiral oblique fracture originating at the ankle joint level. Medial clear space widening can be seen on this view as well.

the proximal tip of the fibular fracture. There was no medial malleolar fracture however there was presence of a medial clear space measuring 6 mm. There was no suggestion of fibular subluxation or syndesmotic injury present. The tibial-fibular overlap measured 1 mm and the tibial clear space measured 6 mm.

The patient was taken for ORIF of the right ankle approximately 3 weeks post injury. The patient was placed under general anesthesia and a thigh tourniquet was applied and inflated to 350 mm/Hg. Local anesthetic with epinephrine was also used for additional hemostasis. An approximately 8 cm incision was created from the fibular shaft extending distally to the tip of the lateral malleolus. Anatomic dissection principles were used and the fracture site was exposed. All hematoma and fibrous tissue present in the fracture site was removed using curettage and irrigation. The fracture could easily be visualized and was reduced by stabilizing the leg and placing distal traction on the foot while pronating and everting the foot. When adequate reduction of the fracture was obtained, an alligator clamp was utilized to maintain position. Three 3.5 mm cortical screws were placed across the fracture employing standard AO technique (Figures 3, 4). Intra-operative fluoroscopy was used for the stress testing portion of the procedure.

Next, the bone hook test was performed, pulling the fibula laterally. This caused the fibula to displace from the mortise and a widening of the medial clear space could be visualized on the AP view. This clearly indicated that correction of the fracture site alone was not enough to stabilize the ankle mortise. It was deemed necessary to place a 4.5 mm fully threaded cortical screw measuring 54 mm across the fibula and tibia approximately 2cm proximal to the ankle joint (Figures 3, 4). The screw was angled anteriorly 30 degrees and parallel to the tibiotalar joint. This screw purchased all 4 cortices and bony purchase and postition were confirmed under fluoroscopy.

The periosteum was closed over the fracture site and soft tissues were closed in a layered fashion with absorbable suture. The patient was placed in a non-weight bearing Jones compression cast. On postoperative readiographic examination, the talus returned to normal postion within the ankle mortise and the medial clear space was reduced to 1-2mm (Figure 3). The length of the fibula was restored and the posterior translation of the distal fibular fracture was eliminated.

Syndesmotic injuries do not always accompany Weber B ankle fractures but are frequently present and unrecognized. Intra-operative testing of syndesmotic stability is a simple yet effective way of assessing these injuries. It is imperative that the injury be recognized and treated by stabilization procedures to decrease the risk for development of arthrosis.

Figure 3. Interfragmentary screw placement visualized here with transsyndesmotic screw placement approximately 1.5 cm from the tibiotalar joint level. Note the parallel orientation of the screw to the joint. The medial clear space has been reduced to 1-2 mm.

Figure 4. Note transsyndesmostic screw placement angle to engage both the fibula and tibia.

BIBLIOGRAPHY

Babis GC, et al. Operative treatment for maisonneuve fracture of the proximal fibula. http://www.orthobluejournal.com, Accessed July 2002.

Boden SD, et al. Mechanical considerations for the sydesmosis screw: a cadaver study. *J Bone Joint Surg Am* 1989;71:1548-55.

Cedell CA. Supination-outward rotation injuries of the ankle. A clinical and roentgenological study with special reference to the operative treatment. *Acta Orthop Scand Suppl* 1967;110:143-8.

Colton CL. Fracture-diastasis of the inferior tibiofibular joint. *J Bone Joint Surg Br* 1968;50:830-5.

Ebraheim NA, et al. Ankle fractures involving the fibula proximal to the distal tibiofibular syndesmosis. *Foot Ankle Int* 1997;18:513-21.

Ebraheim NA, Hossein E, Padanilam T. Syndesmotic disruption in low fibular fractures associated with deltoid ligament injury. *Clin Orthop Rel Res* 2003; 409:260-6.

Harper MC. Delayed reduction and stabilization of the tibofibular syndesmosis. *Foot Ankle Int* 2001;2:15-18.

Kennedy JG, et al. Evaluation of the syndesmotic screw in low Weber C ankle fractures. *J Orthop Trauma* 2000;14:359-66.

McBryde A, et al. Syndesmotic screw placement: A biomechanical analysis. *Foot Ankle Int* 1997;18:262-5.

Muller ME, Weber BG, Colter C. Malleolar Injuries. In Muller ME, Allgower M, Schneider R, Willenegger H (eds). Manual of Internal Fixation. Techniques Recommended by the AO-ASIF Group. Ed 3. Zurich, Springer-Verlag 596-612, 1990.

Relwani, J, et al. Ilizarov ring fixator for a difficult case of ankle syndesmosis disruption. *J Foot Ankle Surg* 2002;49:335-7.

Sinisaari, IP, et al. Ruptured tibio-fibular syndesmosis: Comparison study of metallic to bioabsorbable fixation. *Foot Ankle Int* 2002;22:744-7.

Snedden MH, Shea JP. Diastasis with low distal fibula fractures. *Clin Orthop Rel Res* 2001;382197-205.

Stroud CC. Absorbable implants in fracture management. *Foot Ankle Clin N Am* 2002;7:495-9.

Xenos JS, et al. The tibiofibular syndesmosis. *J Bone Joint Surg Am* 1995;77:847-55.

Yamaguchi K, et al. Operative treatment of syndesmotic disruptions without use of a syndesmotic screw: A prospective clinical study. *Foot Ankle Int* 1994;15:408-14.