FRACTURES OF THE MALLEOLUS WITH SYNDESMOTIC INJURY : A CHALLENGE TO DIAGNOSIS AND TREATMENT

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Fractures of the malleolus associated with syndesmotic injuries are common. Diagnosis of the syndesmotic injury often is missed and requires stress testing. An initial stable syndesmosis on x-ray may get displaced in later x-ray and a high suspicion Index can prevent one from missing this injury. Figure 1 and 2. Accurate reduction and stable fixation of the syndesmosis are critical to outcomes. Unstable syndesmosis is particularly prone to malreduction including translation, rotation, and overcompression. Knowledge of the technical details regarding intraoperative reduction methods and reduction assessment can minimize the risk of syndesmotic malreduction and improve patient outcomes. Figure 3.

Syndesmosis is a complex of ligaments that joins the distal fibula to the distal tibia at the level of the ankle joint. Four main ligaments contribute to the syndesmotic complex: the anterior-inferior tibiofibular ligament (AITFL), the posterior-inferior tibiofibular ligament (PITFL), the transverse ligament, and the interosseous ligament. The AITFL is situated obliquely between the anterolateral tibial (Chaput) tubercle and the anteromedial distal fibula. The PITFL connects the posterolateral tibial (Volkmann) tubercle to the posteromedial distal fibula. The transverse ligament represents a deep, thickened zone of the distal-most portion of the PITFL and functions like a labrum, deepening and stabilizing the tibiotalar joint. The PITFL and associated transverse ligament provide nearly half of the overall syndesmotic strength.[1] The interosseous ligament is the distal aspect of the tibiofibular interosseous membrane and joins the tibia to the fibula several centimeters above the articular surface.[2] A concavity of variable depth and shape known as the incisura fibularis is located at the posterolateral aspect of the distal tibia.[3] The distal fibula fits into this structure, which provides a small amount of bony support to this articulation. However, without the ligamentous stability provided by the syndesmosis, the articulation is rendered unstable to physiologic stresses. In the normal ankle, the stabilizing ligaments of the syndesmosis provide a small amount of elasticity, allowing physiologic motion at the distal tibiofibular joint. With ankle dorsiflexion, the wider anterior talar body rotates into the mortise, requiring posterolateral and proximal translation of the fibula, as well as external rotation.[4] Overall fibular displacement is normally approximately 1 to 2 mm through the entire ankle range of motion. The position of the fibula within the incisura and its relative stability are critical for maintenance of ankle mortise congruity and normal distributionof tibiotalar cartilage forces, minimizing the risk of posttraumatic arthrosis. Because multiple individual structures contribute to distal tibiofibular joint stability, pathological instability presents along a spectrum, depending on the number and severity of structures injured. An untreated syndesmotic

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Figure 1 Fractures of the Malleolus showing a stable syndesmotic injury.

Figure 2 : Xray of the same patient showing displaced fragments with fracture of the posterior malleolus and syndesmotic disruption and displacement.

Figure 3 : Anatomic reconstruction with restoration of the syndesmosis

injury can adversely affect functional outcomes. Additionally, applying unstable fixation to a reduced syndesmosis or stable fixation to a malreduced syndesmosis can lead to poor function.

Plain radiographs of the ankle and tibia should be evaluated for the presence of an ankle fracture, a proximal fibula fracture, and disruption of the normal relationship between the distal tibia and distal fibula. Three radiographic findings have been identified as indicators of syndesmotic injury: increased tibiofibular clear space, decreased tibiofibular overlap, and increased medial clear space.[5]

Tibiofibular clear space is the distance between the medial border of the fibula and the lateral border of the posterior tibia at the incisura. At 1 cm above the joint, the tibiofibular clear space should be 0.6 mm on both the AP and mortise radiographic views. Tibiofibular overlap is the radiographic projection of overlap of the lateral malleolus and the anterior tibial tubercle at 1 cm above the joint. On the AP view, the overlap should be 0.6 mm and, on a true mortise view, it should be 0.1 mm. On the mortise view, the medial clear space is the distance between the lateral border of the medial malleolus and the medial border of the talus, with the ankle at 90 of flexion. The medial clear space should be less than or equalto the superior clear space between the talar dome and the tibial plafond.[5]

CT is commonly employed to diagnose this injury and pre-operatively decide the osteosynthesis plan (Figure 4-5) but it gives information only on bony structures and configurations. Although CT cannot demonstrate instability (Figure 6) at times and may lead to underdiagnosis of clinically significant injuries, MRI demonstrates even the slightest evidence of soft-tissue injury, some of which may not correlate with clinical instability. Therefore, the clinical significance of these diagnostic tools in the management of syndesmotic injury remains unclear. Although there are injury patterns that should heighten concern for instability, few patterns have no risk. According to the Lauge-Hansen classification system, pronation external rotation, supination external rotation, and pronation abduction fractures hold the highest risk of syndesmotic injury. The supination adduction pattern is the only type with minimal risk of instability. Based on the DanisWeber classification system, type B and C fibular fractures have the highest risk of syndesmotic instability, and type A fibular fractures pose minimal risk (note the correlation between the two systems, with the type A fibular fracture pattern seen in the supination adduction fracture pattern). However, many ankle fracture patterns do not conform perfectly to the Lauge-Hansen system. Similarly, severe capsular and ligamentous injuries, which destabilize the syndesmosis, can be present even in Danis-Weber type A fibular fractures. Because missed syndesmotic injuries are associated with inferior results and the current classification systems are imperfect in predicting syndesmotic instability, it is logical to conclude that the syndesmosis should be evaluated intraoperatively in every patient with an ankle fracture.

Although intraoperative manual stress testing provides the advantages of simplicity and efficiency, arthroscopic evaluation of the syndesmosis provides other advantages, including direct visualization of ligaments. First, direct visualization of the AITFL and PITFL ligaments provides clearer evidence of injury to these ligaments than an indirect evaluation of their stability through stress testing.[6] Second, associated injuries, such as loose bodies and osteochondral

Figure 4 : CT scan of the same patient showing communited fracture of posterior malleolus.

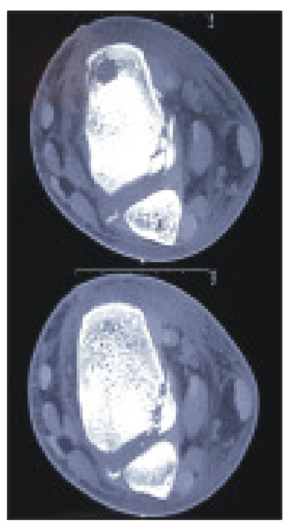

Figure 5 : Transverse view in CT of the same case showing communited fracture of posterior malleolus with syndesmosis avulsion from anterior lip of tibia. AITFL injury. This guides us that instead of specific fixation for posterior malleolus or AITFL an anatomic reduction and holding it in position till healing will give good results.

Figure 6 : CT coronal view of the same patient. A CT scan may at times not give any indication of instability.

defects, may be more completely diagnosed arthroscopically. Third, arthroscopy aids the clinician in defining the different patterns of syndesmotic displacement and assessment of reduction.[7] Disadvantages include the potential for cutaneous nerve injury,[8] overtreatment based on anatomic findings that do not correlate with pathologic instability, andthe increased setup time and logistical complexity of intraoperative fluoroscopy and arthroscopy equipment in the same surgical field. Syndesmotic Reduction and Assessment Following the intraoperative determination or confirmation of a syndesmotic disruption, reduction must be achieved.

Interestingly, a recent study by Song et al[9] demonstrated that 8 of 9 syndesmotic malreductions (89%) spontaneously reduced following screw removal at 3 months postoperatively.

DISCUSSION

The use of a clamp to reduce the syndesmosis frequently leads to inaccurate reduction. Avoiding malrotation, overcompression, and sagittal plane translation can be difficult. The anatomic reconstruction of the fibula (in length and rotation) and reconstruction of the incisura (if either the anterolateral distal tibia or posterior malleolus is fractured) should be prioritized. Following restoration of lateral malleolar length and articulation with a stable syndesmotic incisura, ankle mortise relationships can be restored with the application of a clamp. Syndesmotic reduction is highly sensitive to clamp and screw positioning. A clamp angle of zero leads to the least amount of fibular rotation, but substantial posterior translation and all clamp vectors can lead to overcompression. Intraoperatively, assessment of direct reduction or meticulous fluoroscopic comparison of the injured and contralateral ankles can be helpful to determine the accuracy of the reduction. Restoring the fibula to an anatomic position within the incisura has repeatedly correlated with functional outcomes.

There is a high need to be aware of this injury complex and treat it properly. The injury should be diagnosed pre-operatively so that one plans proper treatment. Intraoperative stability and motion should be evaluated and malreduction should be avoided. A pre-operative MRI can help in diagnosing this injury in time.

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