# Maisonneuve Fracture Equivalent with Proximal Tibiofibular Dislocation

## A Case Report and Literature Review

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The Maisonneuve fracture was initially described in 1840 by Dr. Jacques Maisonneuve[1]. The initial description involved a proximal fibular fracture associated with an injury to the medial ankle structures. Lauge-Hansen then classified this fracture as a pronation-external rotation variant, with disruption of the syndesmosis[2]. Danis[3] and Weber[4] classified these injuries as type-C fractures, and the AO/ASIF Group described them as type-C3 injuries[5].

This pronation-external rotation mechanism involves either an avulsion fracture of the medial malleolus or disruption of the deltoid ligaments. This is followed by an external rotation force that causes disruption of the syndesmotic ligaments and the interosseous membrane. The energy pattern continues along the path of the interosseous membrane and exits in the proximal fibular region. Proximal tibiofibular dislocation initially was described by Dubreuil[6] in 1844 and then by Malgaigne in 1855[7].

We present the case of a patient who sustained a pronation-external rotation injury involving an avulsion of the medial malleolus, with disruption of the deltoid ligaments and the proximal tibiofibular joint. There was no fibular fracture, but the patient did sustain an ipsilateral tibiofibular dislocation. On the basis of our review of the literature, we do not believe that this association has been described previously. The patient was informed that data concerning this case would be submitted for publication.

## Case Report

A seventeen-year-old boy presented to the emergency room after a twisting injury of the left ankle. Initially, he

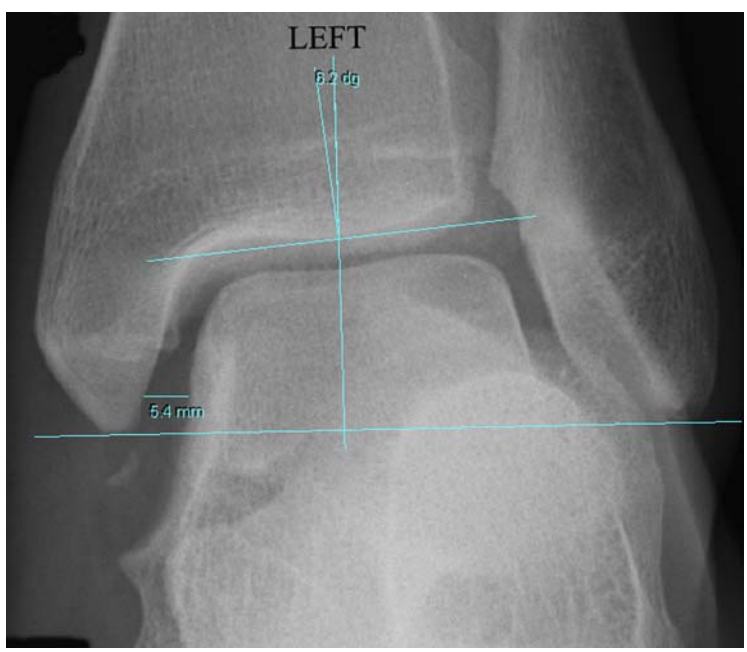


Fig. 1

Stress radiograph of the left (injured) ankle, showing the medial clear space of 5.4 mm and the talocrural angle of 6.2°.

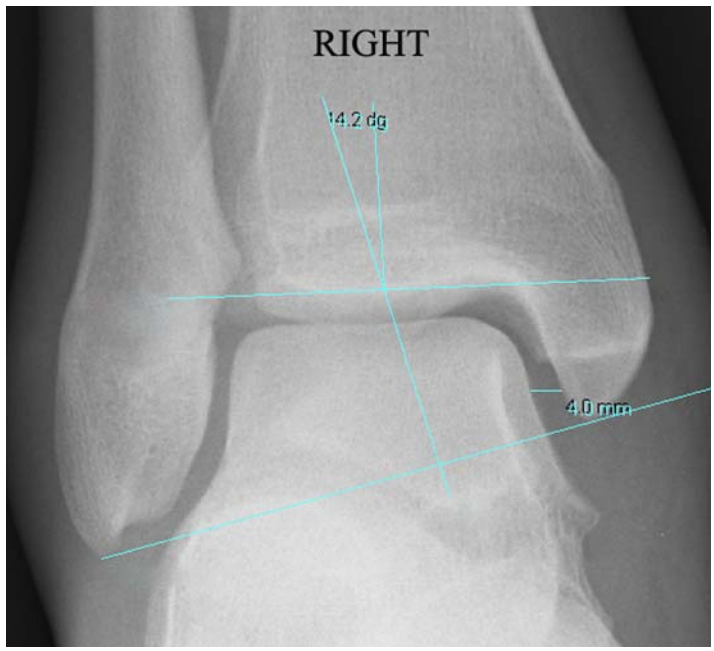


Fig. 2

Stress radiograph of the right (uninjured) ankle, showing the medial clear space of 4 mm and the talocrural angle of 14.2°.

was thought to have an ankle sprain with no evidence of fracture. The patient was managed with a splint because of severe soft-tissue swelling and was referred to the orthopaedic surgery department.

The patient presented to us one week after the injury. At that visit, he was noted to have extensive swelling about the ankle, both medially and laterally, as well as prominence of the proximal tibiofibular joint. Furthermore, the patient had acute tenderness at the proximal tibiofibular joint as well as over the anterolateral joint line and distal to the medial malleolus. The patient also reported pain with external rotation of the ankle. The limb was intact neurovascularly. A review of the

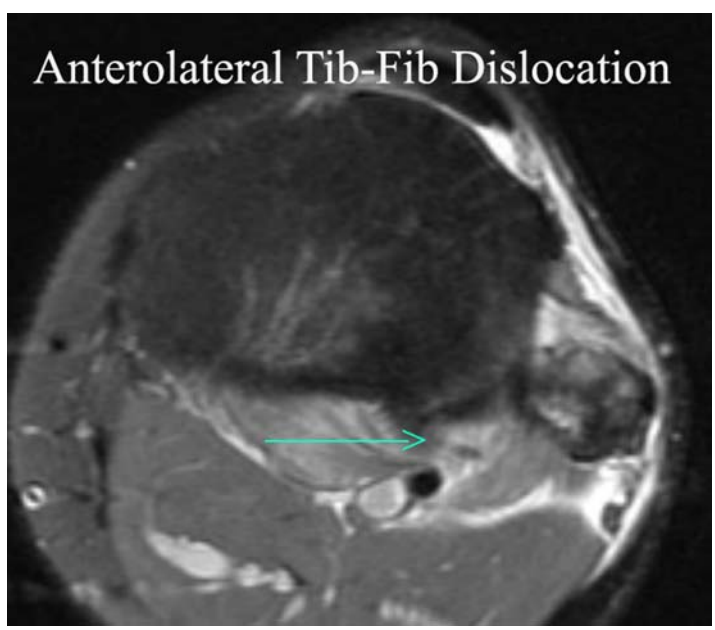


Fig. 3

Fast-spin-echo proton-density-weighted magnetic resonance image of the left knee, with fat suppressions, showing the anterolateral dislocation of the proximal part of the fibula.


Fig. 4
Lateral radiograph of the left knee, showing anterior dislocation of the proximal part of the fibula.

radiographs revealed a small fragment of bone lying just distal to the medial malleolus, consistent with an avulsion-type injury. Comparison stress radiographs demonstrated 4 mm of medial clear space in the uninjured (right) ankle and 5.4 mm of medial clear space in the injured (left) ankle. Although subtle, this did represent abnormal medial clear space widening[8]. The talocrural angle measured 14.2° on the uninjured (right) side and 6.2° on the injured (left) side (Figs. 1 and 2), exceeding the normal side-to-side difference of 2° to 4°[9]. Radiographs as well as magnetic resonance images of the proximal tibiofibular joint demonstrated anterior dislocation (Figs. 3 and 4). These studies were consistent with disruption of the syndesmosis and proximal tibiofibular dislocation.

After a lengthy discussion with the patient and his family with regard to the benefits and risks, the patient underwent surgery ten days after the injury. We were unable to complete a closed reduction of the proximal tibiofibular joint. The fibula was reducible, but it sprang into a dislocated position (Fig. 5). A decision was then made to perform an open reduction of the proximal tibiofibular joint. A 4-cm curvilinear incision, based over the anterior border of the fibula and carried proximally along the posterior border of the iliotibial band, was performed. Dissection was carried through the subcutaneous tissues to the level of the iliotibial band. Further dissection continued posterior to the iliotibial band, exposing the proximal part of the fibula. The peroneal nerve was dissected proximally beneath the biceps femoris muscle belly, and the dissection was carried down to its bifurcation around the fibular head. The proximal part of the fibula was buttonholed through the capsule, but we were unable to reduce it. We then incised the capsule. The fibula then spontaneously reduced into the tibiofibular joint. The fibula was grossly unstable, even after capsular repair, and therefore was held with a transverse 4.5-mm cannulated screw (Fig. 6).

Our attention was then turned to the distal syndesmosis, where a 2-cm incision over the distal part of the fibula was performed. Two 3.5-mm fully threaded cortical screws were placed proximal to the distal tibiofibular joint, capturing four cortices, and were supported with a two-hole plate (Fig. 7). Reduction of the distal tibiofibular joint was confirmed intraoperatively with fluoroscopic examination.

Postoperatively, the patient was kept non-weight-bearing for a twelve-week period. After initial splinting and suture removal at two weeks, he was managed with a removable cast-boot and began knee and ankle range-of-motion exercises. Six months postoperatively, we removed both syndesmotic screws and the proximal tibiofibular screw. Eight months postoperatively, radiographs demonstrated maintenance of the reduction and restoration of a normal medial clear space and talocrural angles. Clinical follow-up at eight months revealed complete restoration of normal proximal tibiofibular contours and full ranges of motion of the knee and ankle. The patient was pain-free and had resumed playing competitive basketball.

Fig. 5
Clinical photograph showing anterolateral dislocation of the proximal part of the left fibula.

Fig. 6
Postoperative lateral radiograph of the left knee.

## Discussion and Literature Review

The Maisonneuve fracture, first described by Dr. Jacques Maisonneuve in 1840, resulted from disruption of the medial structures and a proximal fibular fracture. Subsequently, numerous authors have described variations of this injury pattern involving the medial ankle structures and proximal fibular fractures. Lauge-Hansen then classified these injuries as a variant of the pronation-external rotation pattern[2].

Proximal tibiofibular dislocations initially were described by Dubreuil in 1844[6]. We performed an extensive literature review on both of these injury patterns. To our knowledge, an injury that includes a medial malleolus avulsion combined with a proximal tibiofibular dislocation has not been previously reported.

Jehlička et al.[10] reported on a "Bosworth fracture of the ankle." This injury involved a proximal fibular fracture combined with an ipsilateral distal fibular fracture and a medial malleolar fracture. Slawski and West[11] reported the case of a forty-six-year-old woman who presented with a proximal Maisonneuve-type fibular fracture and an associated distal fibular fracture at the level of the syndesmosis.

Del Castillo and Geiderman[12] described the importance of making proximal tibiofibular radiographs when patients present with ankle pain. Recommendations included the assertion that one should be suspicious of a Maisonneuve fracture pattern when there is an isolated fracture of the posterior tibial tubercle, if there is evidence of deltoid ligament disruption or fracture of the medial malleolus in the absence of a lateral malleolar fracture, if there is tenderness over the anteromedial capsule of the syndesmosis, or if there is tenderness over the syndesmosis. Those authors reinforced the principle of examining both ends of a long bone when a fracture is present at one end. Gabrion et al.[13] described the cases of four patients who had an inferior dislocation of the proximal tibiofibular joint. One of the patients had an associated tibial fracture, but none of them had an associated fibular fracture. Wang et al.[14] reported on the magnetic resonance imaging diagnosis of interosseous membrane injuries in association with

Fig. 7
Postoperative anteroposterior radiograph of the left ankle.

Maisonneuve fractures of the fibula and noted that the interosseous membrane typically was ruptured distal to the distal third of the fibula but that the rupture usually did not extend up to the level of the proximal fibular fracture. Lock et al.[15] reported the case of patient with a missed Maisonneuve fracture who presented with a chief complaint of medial ankle pain and normal radiographs of the ankle. Those authors recommended that the physical examination of all ankle injuries should include the proximal part of the fibula.

Healy et al.[16] reported on a triplane fracture that was associated with a proximal-third fibular fracture in an adolescent wrestler and recommended awareness of the Maisonneuve fracture pattern in association with triplane injuries in the adolescent. Hensel and Harpstrite[17] reported on a Maisonneuve fracture that was associated with a bimalleolar ankle fracture-dislocation. The patient in that study had a distal fibular fracture, a lateral ankle dislocation, a Maisonneuve fracture of the proximal part of the fibula, and a medial malleolar fracture.

## Treatment of Syndesmotic Injuries

The literature related to syndesmotic fixation is controversial with regard to the number of screws, the size of the screws, and the position of the screws relative to the tibiotalar joint. Numerous treatment strategies have been proposed. Weening and Bhandari[18] reviewed the technical aspects of syndesmotic screw fixation and found that, despite variations in treatment, most patients achieved good quality of life and functional outcomes. McBryde et al.[19] recommended placing the syndesmotic screw 2 cm proximal to the joint line. Sproule et al. recommended placing the screw 4 cm proximal to the tibiotalar joint[9]. Thompson and Gesink[20] found that a 4.5-mm screw had no biomechanical advantage compared with a 3.5-mm screw. Xenos et al.[21] found that two screws were biomechanically stronger than a single screw. Duchesneau and Fallat[22] recommended either one or two screws for partial diastasis and two bicortical screws for complete diastasis.

Although generally our preference is to insert two 3.5-mm bicortical screws at sites located 3 and 5 cm proximal to the tibiotalar joint, Jung et al.[23] demonstrated that the use of a plate-screw construct helps to distribute forces across the syndesmosis as compared with the use of two screws alone. In the case presented in the current report, at the time of the surgery, a two-hole plate-screw construct was utilized in an effort to distribute forces on an extremely thin fibula in order to avoid breaking it.

De Souza et al.[24] , in a study of 150 patients who had operative treatment of an external rotation fracture of the ankle, reported a 90% rate of satisfactory results after an average duration of follow-up of 3.5 years. Pankovich[25] reported on seventeen Maisonneuve fractures and recommended surgical treatment when there was a proximal fibular fracture and a rupture of the deltoid ligament or a fracture of the medial malleolus, as in the case of our patient. Obeid et al.[26], in a study of five Maisonneuve-type fractures that were treated with a single suprasyndesmotic percutaneous diastasis screw, reported excellent results and recommended this method as an easy, effective, and minimally invasive procedure with a good functional outcome. Sproule et al.[9], in a review of fourteen patients who had operative treatment of a Maisonneuve fracture, reported an 86% rate of satisfactory results after an average duration of follow-up of 25.3 months. Those authors recommended surgical intervention to maintain reduction of the fibula into the notch of the tibia in order to avoid shortening of the fibula, lateral talar displacement, and subsequent painful ankle arthrosis.

Babis et al.[27], in a report on twenty-six patients who had operative treatment of a Maisonneuve fracture, recommended repairing lateral and medial ligamentous structures with the placement of one or two syndesmotic screws and reported an 88.4% rate of satisfactory clinical results after an average duration of follow-up of 6.5 years. Duchesneau and Fallat[22] performed a literature review on the mechanism of injury, classification, and surgical fixation techniques and recommended surgical treatment for all Maisonneuve fractures to stabilize the fibula and to prevent the shortening with resultant valgus talar shift that can lead to painful degenerative osteoarthritis.

Hardware removal after syndesmotic fixation is controversial[9,18]. In the case described here, the patient was symptomatic in the syndesmotic region with activities. This prompted our recommendation for hardware removal. At the time when hardware removal was scheduled, radiographs showed no evidence of hardware failure. Interestingly, at the time of surgery several weeks later, both syndesmotic screws were broken and were removed.

## Treatment of Proximal Tibiofibular Dislocation

Dislocation of the proximal tibiofibular joint is a rare injury. Ogden described four types of dislocation: subluxation, anterolateral dislocation, posteromedial dislocation, and superior dislocation[28,29]. The diagnosis is based on clinical examination, plain anteroposterior and lateral radiographs, and computed tomography if necessary.

There is a paucity of data regarding the treatment of proximal tibiofibular dislocation in the medical literature. The recommended treatment is closed reduction, which is usually successful[30,31]. Surgery is performed in cases in which reduction is not possible or is not maintained. Van den Bekerom et al.[32], in the largest series that we could find, reviewed eight surgical stabilization procedures that resulted in excellent outcomes. The technique they described is very similar to the one we used and involves an open approach to the proximal tibiofibular joint, mobilization of the common peroneal nerve, fixation with one cancellous screw, and subsequent screw removal after three to six months.

Miettinen et al.[30] described a technique for fixation involving a portion of the biceps femoris muscle tendon and the use of an interference screw for fixation in the proximal part of the tibia. Other authors have recommended reconstructing the joint with an iliotibial band graft, various

forms of Kirschner-wire fixation, and proximal resection of the fibular head[31,33,34].

Although somewhat surprising, we were unable to find an association between a Maisonneuve-type (pronation-external rotation) fracture and an ipsilateral pure proximal tibiofibular dislocation. This injury bears consideration during the diagnostic workup of a patient with an ankle injury. ■

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