Case Report

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New Therapy Option: Maisonneuve Fracture without Transsyndesmotic Fixation

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Abstract

Ankle fracture is one of the common injuries in orthopedic department, the Maisonneuve fracture is a specific type of ankle injury. This fracture is usually caused by rotational force. According to the Lauge -Hansen classification, it is a pronation and external rotation type injury, often resulting in inferior tibiofibular injury. Because it is extremely unstable, it is usually treated surgically. Operative treatment includes medial malleolus fixtion, reduction of the inferior tibiofibular joint and screw fixation. When the fibula fractured is without shortening or dislocation, it is still controversial if inferior tibiofibular joint needs fixation. The aim of this study is to introduce a new method-Maisonneuve without transsyndesmotic fixation and analysis the follow-up result.

Keywords: Maisonneuve fracture; fixation option; plate; screw; ankle function.

Introduction

Ankle fracture is one of the common injuries in orthopedic department. The Maisonneuve fracture was first reported by the French doctor Maisonneuve in 1840 [5, 11, 12, 20]. It's a specific type of ankle injury. It includes injury of the medial structure (medial malleolus fracture or deltoid ligament tear), inferior tibiofibular syndesmosis injury and proximal 1/3 fracture of the fibula. Associated with the posterior tibiofibular ligament or fractures of the posterior malleolus injures sometimes.

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Case Report

A 56-year-old woman was sent to the emergency department by her familiy. She sprained her left ankle when she went down the stairs. She had difficulty walking because of a painful left ankle. Specialized physical examination found tenderness in in the anterolateral distal tibia and fibular neck. X-ray showed fractures in the tibia lateral border and fibular neck, with no evidence of inferior tibiofibular joint dislocation (**Figure 1**&**2**). A computed tomography scan confirmed the presence of Tillaux-Chaput and Volkmann fractures (**Figure 3, 4** and **5**).

Figure 1: *A Fifty-six-year-old woman with fractures in the anterolateral distal tibia.*

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Figure 2: *A Fifty-six-year-old woman with fractures in the fibular neck.*

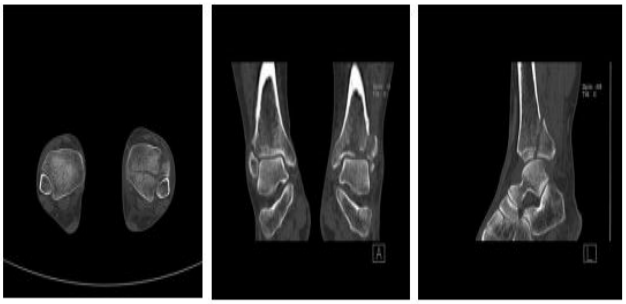

Figure 3: *CT confirmed the presence of Tillaux-Chaput and Volkmann fractures.*

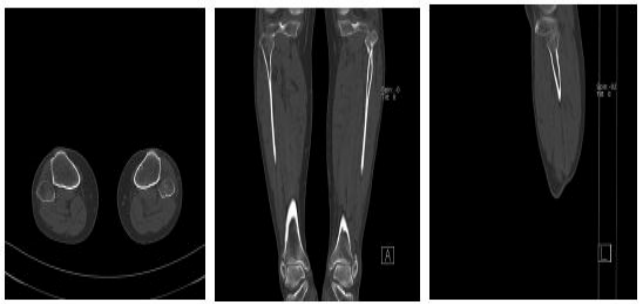

Figure 4: *CT confirmed fractures in the fibular neck.*

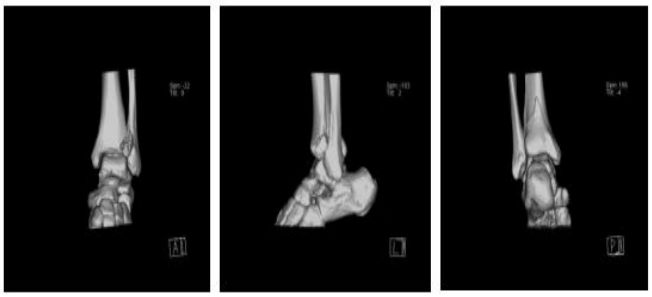

Figure 5: *3D-CT scan.*

Operative Process

The anesthetic for the operation was lumbar anaesthesia. A posterolateral approach was used to expose Volkmann fracture. An anterior tibial approach was used to expose Tillaux-Chaput fracture. The inferior tibiofibular joint was checked carefully. Fractures were reduced and then fixed. Volkmann fracture was fixed by buttress plate, Tillaux-Chaput fracture was performed by hollow screw.Hook test intraoperative was negative. Anatomical reduction and perfect stability were confirmed by X and CT postoperatively (**Figure 6**&**7**). CT scan in transverse section confirmed that the anterior and posterior edge of the distal fibula is in an arc with the fractures of the tibia. It meaned there was no dislocation of the distal fibula. Anterior and posterior ligament of the inferior tibiofibular ligament are in good condition. Three weeks after surgery, patient is required to touch down weightbearing in a plaster splint. Patients are then allowed to partial weightbearing after six weeks and progress to weightbearing. Ankle joint function exercises can be done three weeks after surgery. X noted that the fracture healed without shortening or rotation of the fibula when twelve weeks after surgery (**Figure 8**). The AOFAS score is 92 at twelve weeks follow-up [6, 8].

Figure 6: *Fractures were performed by hollow screw and buttress plate.*

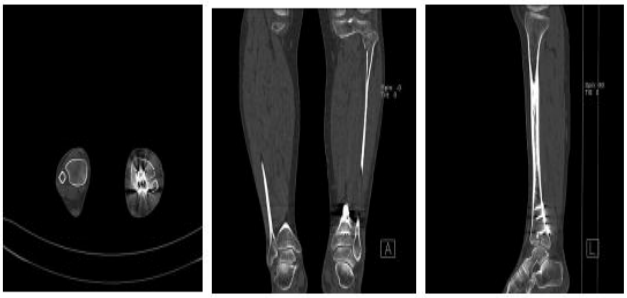

Figure 7: *CT postoperatively confirmed fractures were anatomical reduction and perfect stability.*

Figure 8: *X noted that the fracture healed without shortening or rotation of the fibula when twelve weeks after surgery.*

Discussion

Fracture of the fibula in approximately one-third is an important feature of Maisonneuve fracture [11]. The damage mechanism of Maisonneuve fracture is the 3 or 4 stage of PER (pronation–external rotation) injury in accordance with Lauge–Hansen classification [2, 10, 14]. The first is medial malleolus fracture or deltoid ligament rupture, the second is the rupture of the AITFL (anterior inferior tibiofibular ligament) or avulsion fracture of the AITFL attachment point, the rupture of the IOL(interosseous ligament)and IOM(interosseous membrane) , and the third is fracture of proximal fibula. If the rotational force doesn't end, it's the fourth stage. It is the rupture of the

PITFL (posterior inferior tibiofibular ligament) or the avulsion fracture of the PITFL.

It is well known that mainstream treatment option is fixation of medial malleolus fracture, reduction of the inferior tibiofibular joint and screw fixation [17, 18]. Some scholars have also reported the efficacy of suture-button devices in the treatment of Maisonneuve fracture [4, 19]. There are some defects in screw fixation or suture-button devices.The inferior tibiofibular screw was surgically removed. Treatment costs is more. How to control the pressure and reduction on the tibiofibular joint. Thordarson et.al confirmed contact pressures on inferior tibiofibular malreduction resulting in poorer joint function [16]. In addition, there is a risk of screw breakage in screw fixation [7]. The efficacy of suture-button devices is proven [19]. But previous research by Coetzee et.al suggested that suture-button devices does not guarantee axial stability of the fibula, they recommended plate and screw fixation for Maisonneuve fracture [3]. Klitzman et.al summarized that the mobility of suture-button may promote physiological healing of the inferior tibiofibular ligament [9].

When the fibular fracture is in normal length/rotation, inferior tibiofibular joint fixation or suture-button devices is still controversial. Four factors of ankle stability are medial malleolus, deltoid ligament(mostly deep layer), lateral malleolus and inferior tibiofibular ligament. We image the theory-the stability of ankle joint is a ring. When three-quarters of ring are stable structurally, ankle is stable. So it is with Maisonneuve injury as well.In this type, no fracture with medial malleolus, deltoid ligament is damaged, the fibular is in normal length, but exists rotation due to Tillaux-Chaputand Volkmann fracture. According to the ring theory, Volkmann fracture fixation was performed by buttress plate, Tillaux-Chaput was by hollow screw. Hook test intraoperative was negative. A short leg cast protects the ankle for 6 weeks. According to follow-up, the treatment was effectively.

According to the theory of PER injury, the fourth stage is the rupture of the PITFL(posterior inferior tibiofibular ligament) or the avulsion fracture of the PITFL. Bone and ligament strength varies in different populations. Avulsion fractures of the anterior and posterior inferior tibiofibular ligaments are more common because the epiphyseal is not closed and the ligaments are strong in children. The rupture of anterior and posterior inferior tibiofibular ligament are more common and avulsion fractures at the ligament attachment point are rare, because the bone is stronger than the ligament in young and middle-aged people. Avulsion fractures at the ligamentous attachment point are more common because of osteoporosis in the elderly. Volkmann fracture occurs instead of the rupture of the posterior inferior tibiofibular ligament in this type. We consider the mechanism is pronation–external rotation with ankle plantar flexion. Ankle plantar flexion causes Volkmann fracture, not avulsion fracture. This is similar to an ankle fracture in a child, the posterior inferior tibiofibular ligament (PITFL) is well, but posterior ankle epiphyseal fracture occurrs. Similar Maisonneuve fractures may be more pronounced in children, because ligaments are stronger than epiphyses.

When Maisonneuve fracture with these features-avulsion fractures of the attachment point on inferior tibiofibular ligament, the inferior tibiofibular joint may not be fixed. When the fibula is not shortening and the avulsion fracture is firmly fixed, the inferior tibiofibular joint will be stable.

Conclusion

No transsyndesmotic fixation for Maisonneuve is not the mainstream treatment, but is an new option for Maisonneuve fractures in some cases (children and elderly). Postoperative follow-up confirmed that patients with similar Maisonneuve with the new technique can achieve good function and avoid the need for tibiofibular screw removal, thereby reducing surgical costs. There are still a few defects -only 14 patients.

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