

Treatment and outcome of a patient with low-energy ‘Logsplitter’ injury

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Abstract

The low-energy ‘Logsplitter’ fracture, caused by a sprain or fall, is characterized by an intact or slightly separated inferior tibiofibular joint. Compared with the high-energy ‘Logsplitter’ fracture, this atypical subtype is rarely seen and is easily missed. Here, the case of a 33-year-old male patient with a fractured right ankle as a result of a sprain during walking is reported. The patient initially received routine surgical treatment comprising internal fixation of the fibular, medial and posterior malleoli. Unexpectedly, post-surgery imaging examinations revealed that the medial clear space of the right ankle had widened to 6 mm, due to incomplete reduction of the lateral malleolus, shortening and rotation of the fibula, and an unreduced avulsion fracture block of the anterior malleolus. A revision surgery was then performed to anatomically reduce and fix the lateral malleolus, as well as the anterior malleolus avulsion fracture. During 5 months following surgery, the patient achieved good fracture union and functional restoration of the right ankle. For this rare injury, the present case demonstrates that complete restoration of the fracture is required to achieve good clinical efficacy.

Keywords

Low-energy, Logsplitter injury, Volkmann fracture, Tillaux-Chaput fracture, ankle fracture, incomplete reduction

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Introduction

Ankle fracture is a commonly observed intra-articular fracture in orthopedics,¹ accounting for 9% of all fracture cases.² As a result of different injury mechanisms, the ankle joint may undergo unimalleolar, bimalleolar or trimalleolar fractures. Approximately 11–20% of ankle fractures are complicated by distal tibiofibular syndesmotic injury, which greatly affects ankle joint stability.^{3–5} It is therefore vital to restore the anatomy and stability of the ankle joint for ankle function in such cases. In common types of ankle joint fracture, fixation can achieve a good clinical outcome, however, regarding special fracture types, both an accurate diagnosis and perfect surgical plan are required.

The ‘Logsplitter’ injury was first reported as a special type of fracture injury by Bible et al., in 2014.⁶ This injury is usually caused by a high-energy trauma, resulting in damage to the inferior tibiofibular ligaments, with the talus wedging vertically into the distal tibiofibular joint, and thus, syndesmotic displacement. In addition, the ‘Logsplitter’ injury may contribute to tibial pilon fracture or surrounding soft tissue compromise.⁴ Due to the complicated injury mechanism and the undefined classification, treatment options and outcomes related to ‘Logsplitter’ injuries remain unclear.⁷ The operation to treat a ‘Logsplitter’ injury is of high challenge, with 70% of cases experiencing posttraumatic ankle arthritis.⁸ Cases of high-energy trauma ‘Logsplitter’ fracture have received increased attention, whereas the atypical ‘Logsplitter’ fracture, caused by low-energy injury, is rarely reported. Herein, a rare case of atypical ‘Logsplitter’ fracture is described, with a summary of the treatment process and outcome.

Case report

This study was approved by the Ethics Committee of The Second People’s Hospital Affiliated to Fujian University of Traditional Chinese Medicine, and written informed consent was obtained from the patient for publication of this case report.

A 33-year-old male was admitted to the Emergency Department of The Second People’s Hospital Affiliated to Fujian University of Traditional Chinese Medicine, in December 2020, 8 h after spraining his right ankle while walking. His body mass index was 30.5 kg/m² (weight, 86 kg and height, 1.68 m). The patient reported severe pain and swelling of the ankle, and could withstand limited passive ankle movements but could not perform active ankle movements. The ankle joint was severely malformed and swollen, but without an open skin wound. No other discomfort or past medical history was declared and neurovascular examinations revealed normal findings. Radiographic examination of the ankle showed a displaced medial and lateral malleolus fracture, with a small part of the talus wedged into the distal tibiofibular joint (Figure 1a and b). Subsequent computed tomography (CT) demonstrated trimalleolar fractures (Figure 1c–f). Based on the radiological results, the fracture-dislocation was classified as an AO Foundation/Orthopaedic Trauma Association (OTA) 44C1.1 fracture and supination-external rotation (Lauge-Hansen classification). Due to the extreme ankle instability caused by bone and ligament injuries, surgical intervention was performed 8 days after the injury, when swelling of the foot and ankle had adequately dissipated.

Operative procedure

The patient was placed in a supine position under spinal anaesthesia and tourniquet



Figure 1. Preoperative imaging assessment of a 33-year-old male patient with a fractured right ankle, showing: (a) anteroposterior and (b) lateral X-ray images of the ankle following injury; and computed tomography images showing (c) tibiofibular joint injury (coronal plane); (d) Chaput tubercle displacement (axial plane); (e) posterior 'Volkman' fracture (sagittal plane); and (f) long oblique fracture of the lateral malleolus (sagittal plane).

control. An approximate 12-cm incision was made on the lateral side of the fibula, and soft tissue was then incised by sharp dissection to expose the broken site of the fractured fibula. Following fibula reduction to recover the length, a screw vertical to the fracture line was applied for fracture stabilization. For lateral malleolus internal fixation, there is no difference between locking compression plate (LCP) and conventional one-third tubular plate regarding bone union rate and wound complication rate.⁹ In the present case, LCP was placed for

neutralization. The posterior malleolus was exposed by stripping from the lateral malleolus incision. The avulsion fracture block (Volkman fracture) was then reduced and fixed with a Kirschner wire, with two cannulated screws placed along the direction of Kirschner wire. Next, a curved 5-cm incision was made just in front of the medial malleolus and extended distally to expose the deltoid ligament and its individual components. Fracture displacement of the medial malleolus was observed, and after reduction, a Kirschner

wire and two cannulated screws were applied for fixation. Intraoperative fluoroscopy showed good reduction of the medial malleolus fracture. Anteroposterior and lateral films of the right ankle, obtained on the first postoperative day, revealed that the medial clear space of the right ankle was widened to 6 mm (4 mm wider than the normal side; Figure 2a). A CT scan of the right ankle showed that the widened medial malleolus mortise was attributed to incomplete reduction of the lateral malleolus, shortening and rotation of the fibula (Figure 2b), and an unreduced avulsion fracture block of the Chaput tubercle (Figure 2c).

Considering the possibility of traumatic arthritis caused by the widening medial malleolus mortise, revision surgery was performed under spinal anaesthesia 5 days after the initial surgery. The original plate and screws of the lateral malleolus were removed during the operation, and the lateral malleolus was completely reduced and fixed with an LCP. The Chaput tubercle fracture fragment was then exposed using a 4-cm incision. The avulsion fracture was anatomically reduced temporarily with a fine Kirschner wire and fixed using a cannulated screw. Subsequent postoperative

X-ray examination showed a well reduced and aligned distal tibiofibular syndesmosis (Figure 3a and b). At 2 months following surgery, partial weightbearing was tolerated on the right leg with the assistance of a single crutch. Full weightbearing was tolerated at 4 months following surgery, and at 5 months after surgery, an X-ray examination showed union of the fracture and good position of the right ankle joint (Figure 3c and d). The right ankle was free of pain, with a range of dorsiflexion and plantarflexion that was almost parallel with the contralateral side (Figure 3e-g), and an American Orthopaedic Foot and Ankle Society Score (AOFAS) of 90 was achieved.¹⁰

Discussion

The 'Logsplitter' fracture is caused by low-energy injuries, such as sprain or fall, and is characterized by intact or slightly separated inferior tibiofibular joint with avulsed fractures at the attachment of the anterior and posterior tibiofibular ligaments, namely, the tubercle of Tillaux-Chaput (also known as the Chaput tubercle) fracture and the Volkmann fracture, respectively.¹¹ The tubercle of Tillaux-Chaput and

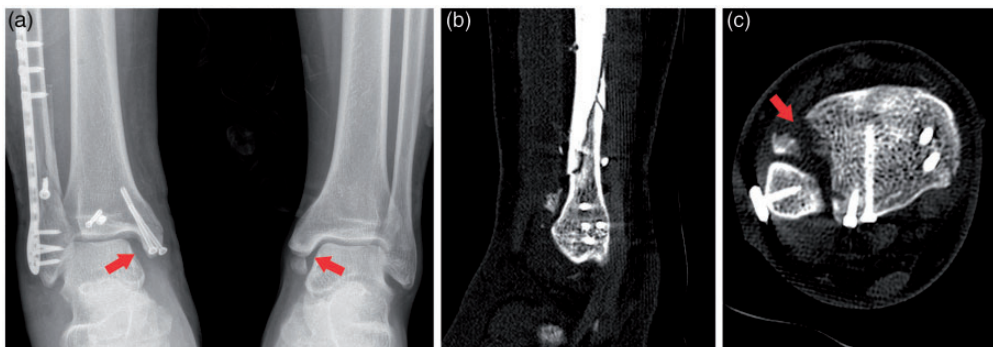


Figure 2. Imaging assessment following first surgical treatment of a right ankle fracture in a 33-year-old male patient: (a) an anteroposterior radiograph of bilateral ankles with the right medial ankle mortise (red arrow) shown to be 4 mm wider than the contralateral side; and computed tomography images showing (b) incomplete reduction of the lateral malleolus, and shortening and rotation of the fibula (sagittal plane); and (c) an unreduced avulsion fracture block of the anterior malleolus (red arrow; axial plane).



Figure 3. Imaging and functional observations following revision surgery to treat a right ankle fracture in a 33-year-old male patient: (a and b) X-ray images showing the anatomical replacement following revision surgery; (c and d) X-ray images showing fracture union at the 5-month follow-up; and (e–g) representative images showing functional restoration of the injured ankle at the 5-month follow-up.

Volkman fragments are initially caused by rotational force, then partial talus dislocation by vertical force, resulting in incomplete syndesmotic separation and widened mortise.⁷

The ‘Logsplitter’ fracture mainly focuses on the injured tibiofibular ligament complex, which is vital for tibiofibular joint and ankle stability. Poor reduction of the lower tibiofibular joint tends to cause biomechanical instability of the ankle joint, and increase the incidence of ankle pain and arthritis in the long term.¹² If the width of the medial malleolus space is greater than 4 mm, then separation of the tibiofibular syndesmosis should be highly suspected.¹³ According to Harper et al.,¹⁴ an inferior tibiofibular space of >5 mm or >2 mm compared with the normal side will significantly increase the long-term incidence of ankle arthritis. Compared with lateral shift and external rotation, fibula shortening has been shown to have the

greatest effect on the articular surface pressure of the talus.¹⁵ The close association between shortening or external rotation of the fibula and widening of the medial malleolus has also been reported by Hansen et al.¹⁶ Therefore, anatomical reduction of tibia and fibula fractures is required to ensure stability of the lower tibiofibular joint in cases of ‘Logsplitter’ fracture.

The syndesmotic ligament is composed of anterior and posterior tibiofibular ligaments, and the interosseous ligament. The anterior and posterior tibiofibular ligaments provide 35% and 42% of the strength, respectively. In the present case, the patient experienced tubercle of Tillaux-Chaput and Volkman fractures, with the latter regarded as a posterior malleolus fracture. According to Van den Bekerom et al.,^{17,18} fixation of the posterior malleolus fracture will stabilize the lower tibiofibular joint, since the posterior tibiofibular ligament remains completely attached to the

displaced fracture block. Consistent with this view, the stabilization effect of fixation on the lower tibiofibular joint is thought to be equivalent to that of the lower tibiofibular screw,¹⁹ and fixation of the posterior malleolus has been shown to allow the patient to bear full weight through the ankle as soon as the soft tissues permit.²⁰ The tubercle of Tillaux-Chaput fracture is a relatively rare type of ankle fracture that is easily missed, and incomplete reduction and immobilization may destabilize the tibiofibular joint and affect ankle function in the long term. In the present case, due to the small size of the Chaput tubercle fracture piece and insufficient understanding of the injury, the fracture piece was not fixed, which was also one of the reasons for the widened tibiofibular syndesmosis. Eventually, the inferior tibiofibular joint of the patient achieved adequate stability after fixing both the anterior tubercle of Tillaux-Chaput fracture and the posterior Volkmann fracture. Therefore, the inferior tibiofibular screw was not placed.^{21,22}

Conclusion

The atypical ‘Logsplitter’ fracture, caused by low-energy trauma, is rare and easily missed during diagnosis. Restoring the normal anatomical structure of the ankle joint is crucial to achieving clinical efficacy. Complete correction of the shortening and rotation of the lateral malleolus is required to avoid widening of the ankle mortise. In addition, the fixation of tubercle of Tillaux-Chaput and posterior malleolus avulsion fractures may reduce the need to place tibiofibular screws, thereby avoiding related complications, such as screw loosening and breakage, heterotopic ossification, and fibular deformity reduction.²³ The ‘Logsplitter’ fracture rarely involves the deltoid ligament, which does not usually require repair.³

Declaration of conflicting interest

The Authors declare that there is no conflict of interest.

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