Case Report

SAGE Open Medical Case Reports

SAGE Open Medical Case Reports
Volume 8: 1–7

DOI: 10.1177/2050313X20974525
journals.sagepub.com/home/sco
SAGE

Ankle arthroscopy–assisted closed reduction in Bosworth fracture dislocation

Shuangjian He[1] and Jian Zhu[2]

Abstract

The Bosworth fracture dislocation is a rare type of ankle fracture and is usually unrecognized on initial radiographs, therefore early open reduction is recommended. This study reports a 51-year-old female with uncommon imaging and clinical features. Preoperative X-ray, computed tomography, and magnetic resonance imaging of the ankle showed posterior detached dislocation of the intact distal fibula, the loose osteochondral fragments located in the tibiotalar joint, and the rupture of the deltoid ligament. Due to the initial infected wound on the severely swollen ankle, delayed arthroscopy-assisted closed reduction and internal fixation, removal of loose bodies, and repair of the deltoid ligament were performed, 19 days after injury. Postoperative imaging, including the X-ray, computed tomography, and magnetic resonance imaging, demonstrated the anatomic reduction of the ankle joint. After 6 months of follow-up, the patient gained a pain-free motion of the ankle with a range of passive 10° dorsiflexion and 40° plantar flexion, and resumed her normal gait and activity. This report indicates that the detached posterior dislocation of the intact distal fibula is a rare variant of the Bosworth fracture dislocation, and suggests that arthroscopy-assisted closed reduction and removal of loose osteochondral fragments in joint space are useful technique for this special type of the Bosworth lesions.

Keywords

Ankle, Bosworth, fracture, dislocation, fibula, arthroscopy

Date received: 15 July 2020; accepted: 28 October 2020

Introduction

The Bosworth fracture dislocation is a rare type of ankle injury which was first described by Bosworth.[1] This special type of fracture dislocation is usually irreducible due to the fixed dislocation of the distal fibula entrapped behind the posterior tubercle of distal tibia.[2,3] The mechanistic basis of this injury was explored by many investigators, and it is believed that a twisting of the foot leads to Danis–Weber Type-B and Lauge-Hansen supination-external rotation-type fracture.[3,4] According to the previous pilot study, early accurate diagnosis and proper treatment are suggested to avoid the associated complications, and to achieve the optimal function of the ankle.[5,6] However, timely identification and proper management of Bosworth fracture dislocation are usually challenging. Furthermore, the lack of full recognition or misdiagnosis for the initially radiological features are usually contributed to the delayed or inappropriate treatment, which may result in a disastrous outcome and compromised ankle function. Most of the literature recommends early open reduction and internal fixation.[2,6–8] The purpose of our study was to report a 51-year-old female case, which might be a particular variant of Bosworth fracture dislocation, diagnosed with rare clinical and imaging results, which includes a delayed infected wound, posterior locked dislocation of the intact distal fibula, the loose osteochondral fragments in the posterior-medial tibiotalar joint, and the rupture of the deltoid ligament.

In addition, in this case, we successfully demonstrated the use of relatively minimally invasive arthroscope-assisted surgery for closed reduction and percutaneous fixation of the

[1]Department of Orthopaedics, The Affiliated Suzhou Science and Technology Town Hospital of Nanjing Medical University, Nanjing, P.R. China
[2]Department of Orthopaedics, Taixing People's Hospital, Yangzhou University, Yangzhou, P.R. China

Corresponding Author:
Jian Zhu, Department of Orthopaedics, Taixing People's Hospital, Yangzhou University, No.1, Changzheng Road, Yangzhou, Taixing 225400, P.R. China.
Email: txryzjgk@sina.com

distal fibular rigid dislocation, which partially contradict with previous studies on the method of distal fibular reduction.

Case report

In July 2019, a 51-year-old female was injured in a traffic accident and subsequently sent to a local emergency department. She complained of intense pain in her severely injured ankle, which has the obvious deformity and severe soft-tissue swelling with a minor wound bleeding on the anteromedial region. Luckily, vascular and neurologic impairment and compartment syndrome were not observed. The initial plain film radiographs on anteroposterior (AP) showed obvious separation of the lower tibiofibular syndesmosis, widened medial joint space of the ankle, and oblique fibular fracture in the proximal third part of the shaft. The lateral view of radiographs showed posterior displacement of the intact distal fibula with no fracture and posterior dislocation of the talus (Figure 1). Next, the manually closed reduction under sedatives condition was conducted. Unfortunately, the distal fibula was unchanged and still fixed in the original displaced position, and could not be reduced. Meanwhile, the talus was observed with posterior subluxation. After dressing the anteromedial ankle open wound and applying a long-leg cast, the patient was admitted to the ward of the local hospital for further routine treatment.

Six days after the injury, the patient was shifted to our institution. However, the operation was postponed due to the infection in the wound and the ankle joint was completely swollen. Next, we gave antibiotics, changed the dressing of the infectious wound, and gave necessary exercise to the immobilized lower limbs. To further assess the injured ankle, computed tomography (CT) and magnetic resonance imaging (MRI) scans of the injured ankle, and X-rays of the healthy ankle on AP and lateral views, were performed. Axial CT images showed that the intact distal fibula was displaced from the normal tibial notch and fixed behind the posterolateral tibial tubercle. Unexpectedly, multiple free osteochondral fragments were found between the distal tibial plafond and the talar dome, which were also observed in the subsequent MRI images (Figure 2). In addition, MRI of the coronal plane revealed the rupture of the deltoid ligament (Figure 3).

At 19 days after injury, the infection and swelling of the ankle joint had been obviously reduced. Ankle arthroscopy–assisted surgery was conducted to minimize the risk of intraoperative trauma and postoperative complications. The operative procedure is described below.

First, ankle arthroscopy (2.7 mm, 30 arthroscopes) under thigh tourniquet was performed using standard anteromedial and anterolateral portals without traction. The hematoma and several osteochondral loose fragments (size ~0.5 to 1 cm^2) located in the middle and medial side of the posterior tibiotalar space were smoothly removed after the ankle plantar flexion (Figure 4). The other bone fragments attached to the posterior capsule are located behind the posterior malleolus

Figure 1. Initial radiographs after injury. (a) Distal AP and lateral radiographs showing a significant separation of the syndesmosis, widened medial joint space, intact distal fibula posterior displacement, and posterior dislocation of talus. (b) Oblique fibular fracture in the proximal third of the shaft.

and do not need to be removed because they do not affect ankle movement. According to preoperative CT and intraoperative exploration, we confirmed that the free bone fragments were avulsed from the posterior distal tibia surface. Because of the small size of cartilage defect, no microfracture treatment was performed. Second, the surgeon attempts to clamp the distal fibula with cloth forceps, apply outward and forward force, and pull the distal fibula with posterior dislocation out of the posterior distal tibia and then reposition the distal fibula to the lower tibiofibular notch with internal rotation force. Then, two 3.5-mm quadricortical lag screws transversely fixed the syndesmosis with the ankle held in dorsiflexion of 90°. All the procedures were monitored with C-arm X-ray. Although X-ray and arthroscopic examination showed an anatomical and stable reduction of the syndesmosis, however, a slightly widened medial joint space was observed compared to the normal left mortise. We assumed it might be related to the rupture of the deltoid ligament. Then, a medial approach was performed to observe the partial whole layer of deltoid ligament avulsed from the medial malleolus, which was consistent with the preoperative MRI scan findings. Finally, two anchor sutures were inserted into the tip of the medial malleolus to repair the torn deltoid ligament (Figure 4). The final intraoperative radiographic AP and lateral views showed closely anatomical ankle joint space and a satisfactory syndesmosis position. Postoperative images of X-ray and CT also showed acceptable position of the injured ankle (Figure 5).

Postoperatively, a plaster cast was applied for 4 weeks and non-weight bearing for 2 months was advised after surgery. The progressive postoperative rehabilitation protocol was well complied by the patient. Three months after surgery, the syndesmosis screw was removed, and the subsequent images of X-ray and MRI showed a satisfactory position of the ankle joint and the continuous deltoid ligament (Figure 6). At the last follow-up of 6 months, the patient recovered well and

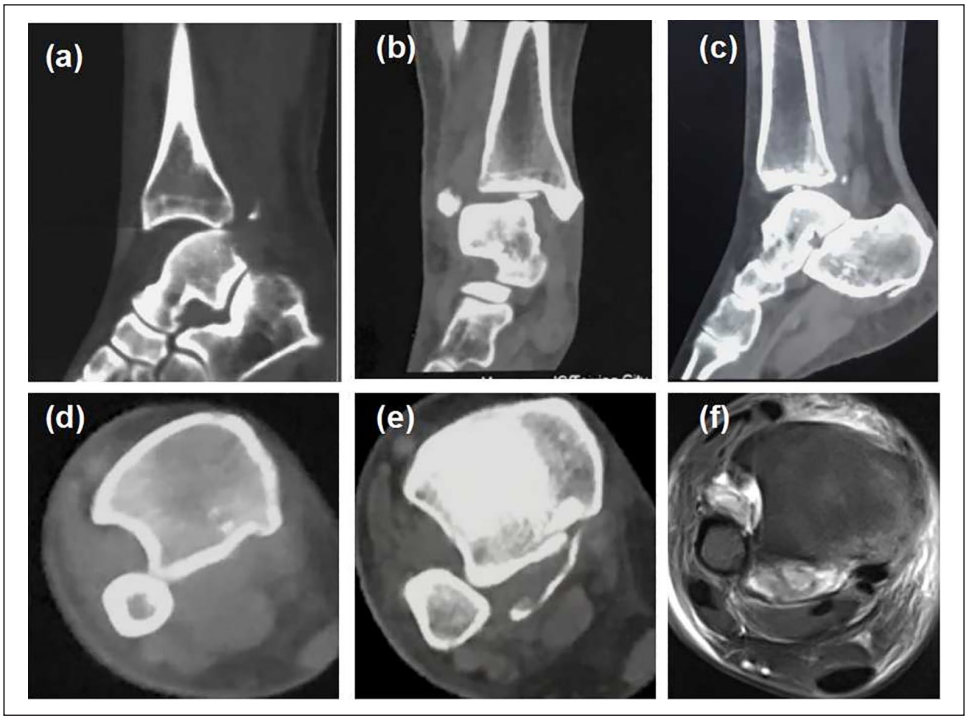

Figure 2. Preoperative CT and MRI images after manually closed reduction. (a) Posterior subluxation of talus and avulsed fractures of the posterior malleolus on the lateral view of CT scan. (b, c) Loose osteochondral fragments in the tibiotalar joint space on both the coronal and the sagittal views of CT scan. (d–f) Distal fibula posteriorly displaced from the normal tibial notch and fixed behind the posterolateral tibial tubercle, and avulsed fracture of the posterior malleolus on an axial view of CT and MRI images.

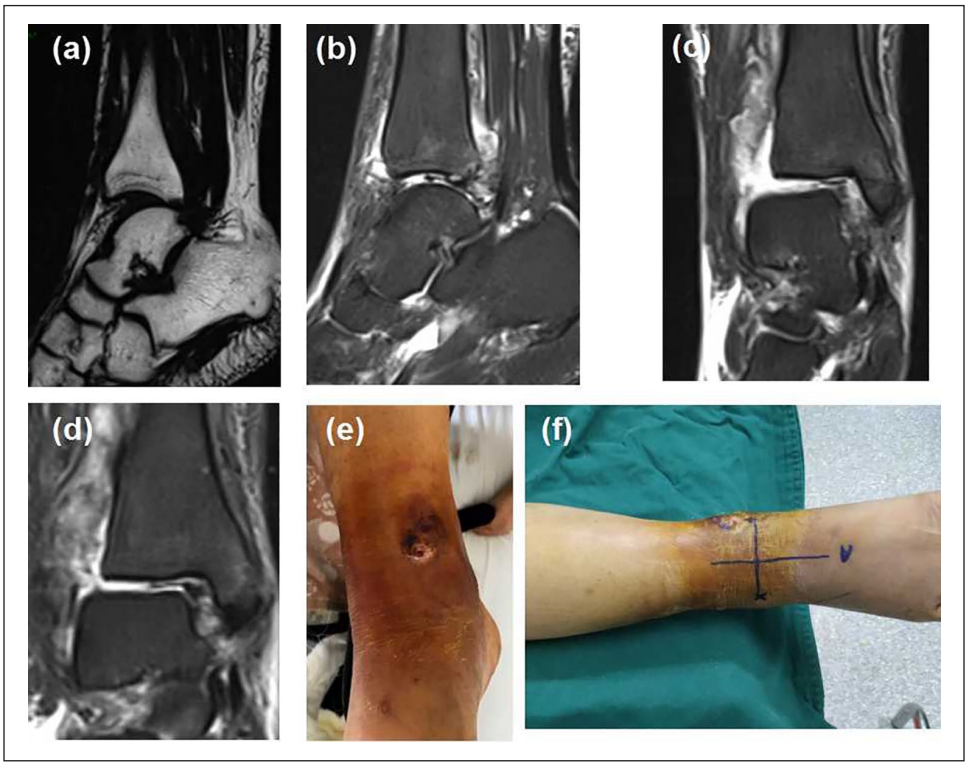

Figure 3. Preoperative MRI images and a cured infectious wound on the anteromedial region of the ankle. (a) Posterior subluxation of the talus on a sagittal view of MRI. (b–d) Loose osteochondral fragments in the tibiotalar joint on both coronal and sagittal view of MRI, and the rupture of the deltoid ligament on coronal view of MRI. (e, f) A cured infectious wound on the anteromedial region of the ankle.

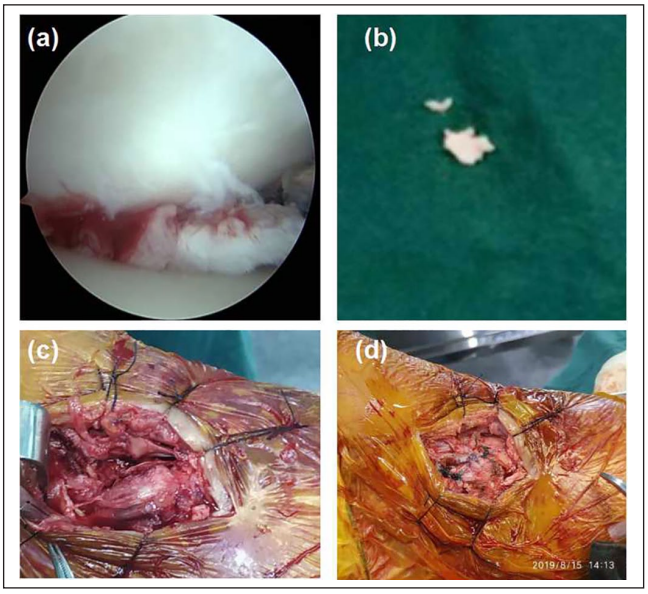

Figure 4. Removal of loose osteochondral fragments in the tibiotalar joint and repair of the deltoid ligament. (a, b) Removal of loose osteochondral fragments with arthroscopy technique. (c, d) Preoperative ruptured and postoperative repaired deltoid ligament.

obtained a pain-free range of motion of the ankle with passive 10° dorsiflexion and 40° plantar flexion (Figure 7), and luckily resumed her normal gait and daily activities. The American Orthopaedic Foot & Ankle Society (AOFAS) Ankle-Hindfoot Scale[9] score was 92 points at the final follow-up.

During the follow-up period, complications such as skin necrosis, infections, stiffness, and hardware failure were not observed.

Discussion

The Bosworth fracture, initially reported by Bosworth,[1] is considered to be a rare type of ankle injury characterized by difficulty in closed reduction. Among the limited available reports, the generally accepted injury mechanism is external rotation of the supinated foot, whereas the Bosworth fracture is always the supination-external rotation type, based on cadaveric experiments.[4,7,10] However, the similar injury mechanism can cause different fracture patterns. Bartonicek et al.[7] reported that Weber Type B fractures occur in approximately 88% (43 of 49) of patients diagnosed with Bosworth fracture.

So far, no radiological persistent characteristics have been reported that could help surgeon in early diagnosis

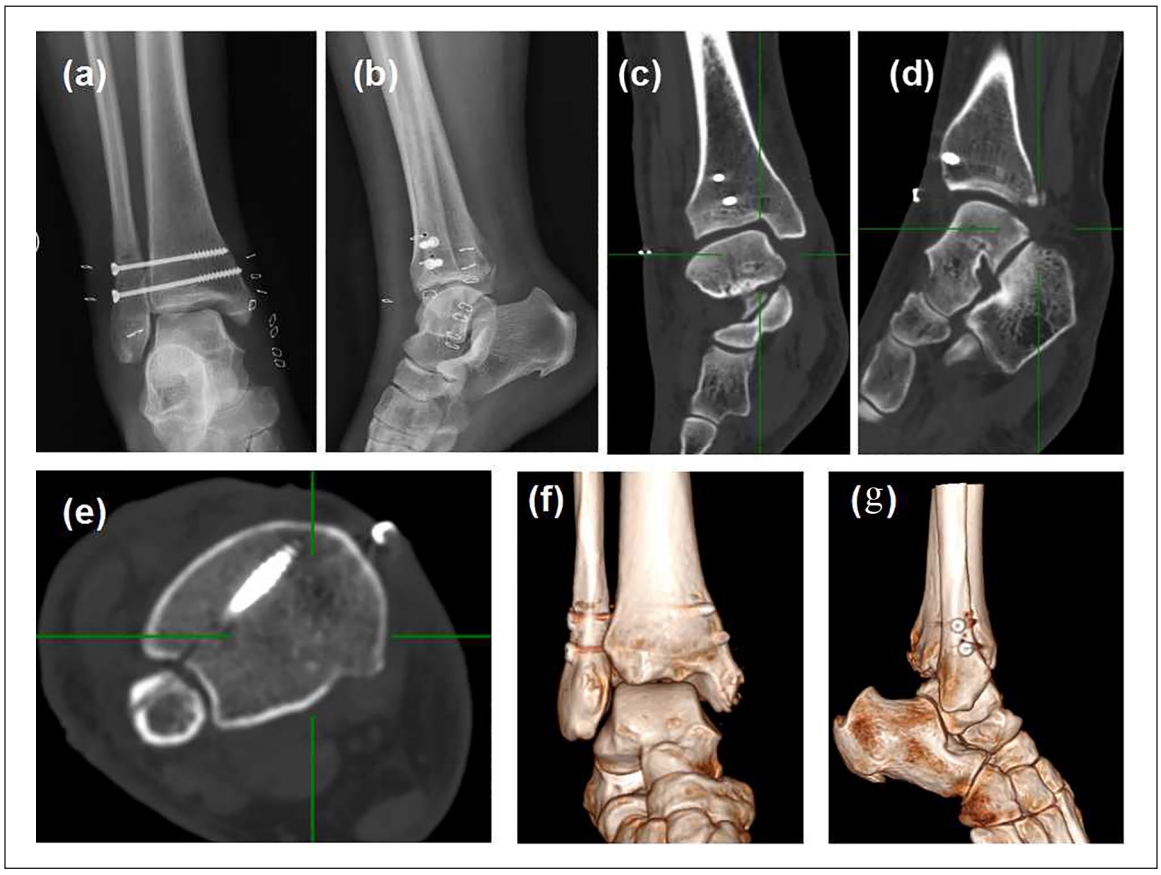

Figure 5. Postoperative images showing the satisfactory position of the injured ankle. (a, b) Postoperative radiographs showing full reduction of the distal dislocated fibula and near anatomical joint space of the ankle. (c, d) Satisfactory tibiotalar joint space on both coronal and sagittal views of CT scan. (e) Full reduction of the syndesmosis on an axial view of CT scan. (f, g) Postoperative 3D reconstructions of CT showing the syndesmosis fixation with two quadricortical lag screws and the nearly normal ankle joint position.

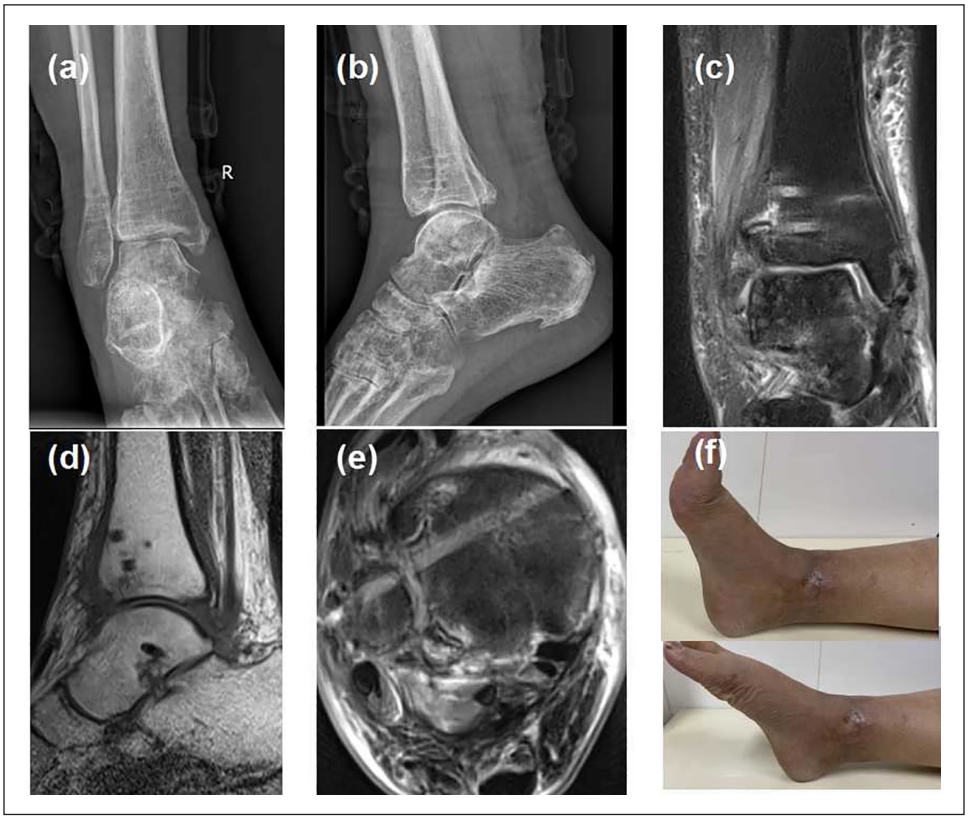

Figure 6. Patient showed good imaging appearances and a satisfactory clinical outcome after removing the hardware, 15 weeks after surgery. (a, b) Radiographs on AP and lateral view showing the normal position of the ankle. (c) Continuous appearance of the deltoid ligament on the coronal view of ankle MRI. (d, e) Tibiotalar joint and syndesmosis on sagittal and axial views of MRI. (f) Pain-free range of motion of the ankle with active dorsiflexion and plantar flexion.

and recognizing the nature of the injury.[10] However, early recognition of the common radiographic features, such as distal tibiofibular overlap on AP view, distal fibula posterior displacement on the lateral view, and medial joint space widening, is useful to avoid misdiagnosis of Bosworth lesion, although they have potential challenges.[11] Some scholars have reported that about 70% of Bosworth fractures are associated with posterior ankle fractures. Early CT examination is helpful to find Bosworth fractures associated with posterior ankle fractures.[11] In addition, the morphology of the Bosworth variant is usually changed with age, which is helpful in identifying the Bosworth lesion. Reportedly, the Bosworth fracture dislocation have some known characteristics, including common distal fibular fractures with proximal shaft posterior dislocation, rare intact distal fibular posterior dislocation, posterior distal tibia avulsed fracture, pilon fracture, deltoid ligament rupture, medial malleolus fracture, epiphyseolysis fracture, osteochondral lesions, the interosseous membrane lesions, anterior and posterior tibiofibular ligaments injury, and interposition of tissues in joint space.[12–14] Furthermore, early identification of neurovascular impairment and compartment syndrome is vital to avoid catastrophic complications.[15]

To the best of authors' knowledge, only a few studies have reported the incidence rate of this rare type of ankle injury. Won et al.[6] reported that the incidence of Bosworth fracture dislocations in patients with ankle fractures was 1.62% (51 of 3140 cases), but the preoperative diagnostic rate was only 56.86% (29 of 51 cases). Bosworth fracture dislocation is often unrecognized on initial radiographic imaging, and hence the actual prevalence remains unclear.[8] Some reported methods, including "Axilla sign" on plain AP radiographs of the mortise, external oblique ankle radiographs, and CT scan, are considered to be useful for the preoperative diagnosis of the Bosworth fracture.[3–5,10]

To minimize the potential complications, such as skin necrosis, osteochondral lesions, ankle stiffness, and even posttraumatic arthritis, a single attempt of manually closed reduction, no-delayed open reduction, and internal fixation for the Bosworth fracture was advised by most researchers.[3,4,7,11] Indisputably, we strongly agree that repeated attempts of closed reduction should be avoided, and the surgery should be performed as early as possible. In addition, the use of CT scan for early diagnosis, the application of two quadricortical lag screws for the fixation of syndesmosis, and the progressive postoperative rehabilitation programs in our study are in good agreement with previous studies[7,16]

However, other treatment strategies regarding this case were contrary with previous studies' approaches. First, we applied MRI to evaluate the potential ankle injury. Usually,

Figure 7. Satisfactory radiographic and clinical outcome, 26 weeks after surgery. (a, b) Radiographs on AP and lateral view showing the normal position of the ankle. (c, d) Radiographic bone union of proximal fibular fracture. (e, f) Active dorsiflexion and plantar flexion of bilateral ankle joint.

most researchers propose the routine use of CT scan to visualize and assess the severity of ankle fracture, but there is no clear reported evidence to confirm the necessity of using MRI for preoperative diagnosis of the Bosworth fracture. However, we consider that the acute edema of the ankle may have diminished significantly within 10 days after injury. The preoperative application of MRI may have a positive effect on identifying ligament rupture, cartilage injury, and other potential injuries. Second, early surgical intervention has been proposed by previous studies to avoid late complications, but in the present case, successful surgery was conducted at 19 days after injury. We consider that this is a special case; because of severely swollen ankle and an infected wound, early surgical intervention may increase the risk of joint infection and skin necrosis or break-down. Therefore, it may be reasonable to delay the surgery until the infection has been completely controlled and the severe skin swelling has been subsided. Third, we performed closed reduction rather than open reduction for the posterior dislocation of the distal fibula. Actually, the presented case showed some unusual radiological appearances including the posterior fixed dislocation of the intact distal fibula, the distinct detachment of syndesmosis, and the loose fracture fragments in tibiotalar joint. These appearances were significantly different from the previously reported types of Bosworth injury which commonly presented with distal fibular fracture, posterior dislocation of the proximal fracture fragment, and the distal tibiofibular overlap on AP view. We supposed the intact segregation of the distal fibula, no interposition of hard tissue on the tibiofibular notch predicted from CT and MRI imaging, and the application of anteromedial pulling and internal rotation force to the proximal entrapped fragment of the fibula might facilitate the successful closed reduction in this unusual case. Actually, it has been reported that applying internal rotation forces can help the successful reduction of the posterior dislocated proximal fibula fragment.[16] Finally, we believe that ankle arthroscopic technique can be used to remove the joint hematoma and osteochondral loose fragments conveniently,[17] to evaluate syndesmosis reduction visually and to decrease operative trauma minimally.[18] In fact, the use of the arthroscope to clean the interposition tissue such as hematoma and free fracture firmaments can also help the smooth reduction of the syndesmosis and the tibiotalar joint, which was confirmed in the previous study.[17]

In summary, imaging, clinical characteristics, and even surgical strategies in our current case are partially contrary with previous studies. We believe the current case may be a rare variant of the Bosworth fracture dislocation. Due to the unique features of this case, we applied a thoughtful and

appropriate treatment protocol, and fortunately achieved satisfactory results. Our study also has some limitations. First, our study lacks having longer follow-up to assess the eventual effect of treatment and to observe some progressive or degenerative late complications. Second, we also need further studies in more cases to provide more convincing evidence to verify the advancement and feasibility of our methods for this special type of Bosworth fracture dislocation.

Conclusion

The Bosworth fracture dislocation is a rare type of ankle injury with various imaging and clinical appearances. Early correct diagnosis, comprehensive preoperative evaluation, and personalized optimal treatment, according to the injury characteristics, are essential factors to achieve good clinical results. Our study indicates that the detached posterior dislocation of the intact distal fibula is a rare variant of the Bosworth fracture dislocation, and suggests that arthroscopy-assisted closed reduction and internal fixation seem to be a useful technique for this special type of the Bosworth lesions.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Ethical approval

Ethical approval to report this case was obtained from the Institutional Review Board of Taxing People's Hospital (IRB No. 2019-0009). All clinical records and radiological data for this study were obtained with the approval of the IRB.

Informed consent

Written informed consent was obtained from the patient for their anonymized information to be published in this article.

ORCID iDs

Shuangjian He https://orcid.org/0000-0003-4935-5235
Jian Zhu https://orcid.org/0000-0001-7014-5174

References

1. Bosworth DM. Fracture-dislocation of the ankle with fixed displacement of the fibula behind the tibia. *J Bone Joint Surg Am* 1947; 29: 130–135.
2. Wright SE, Legg A and Davies MB. A contemporary approach to the management of a Bosworth injury. *Injury* 2012; 43(2): 252–253.
3. Foldager CB, Barckman J, Robertsen K, et al. Bosworth fracture dislocation of the ankle: – two case reports with perioperative illustration. *Trauma Case Rep* 2018; 17: 39–42.
4. Peterson ND, Shah F and Narayan B. An unusual ankle injury: the Bosworth-pilon fracture. *J Foot Ankle Surg* 2015; 54(4): 751–753.
5. Yang KH, Won Y, Lim JR, et al. Assessment of Bosworth-type fracture by external oblique radiographs. *Am J Emerg Med* 2014; 32(11): 1387–1390.
6. Won Y, Lee GS, Hwang JM, et al. Improved functional outcome after early reduction in Bosworth fracture-dislocation. *Foot Ankle Surg* 201825: 798–803.
7. Bartonicek J, Fric V, Svatos F, et al. Bosworth-type fibular entrapment injuries of the ankle: the Bosworth lesion. A report of 6 cases and literature review. *J Orthop Trauma* 2007; 21(10): 710–717.
8. Cho BK, Choi SM and Shin YD. Prognostic factors for intermediate-term clinical outcomes following Bosworth fractures of the ankle joint. *Foot Ankle Surg* 2018; 25: 601–607.
9. De Boer AS, Tjioe RJC and Fleur VDS. The American Orthopaedic Foot and Ankle Society Ankle-hindfoot scale; translation and validation of the Dutch language version for ankle fractures. *BMJ Open* 2017; 7(8): e017040.
10. Schepers T, Hagenaars T and Den Hartog D. An irreducible ankle fracture dislocation: the Bosworth injury. *J Foot Ankle Surg* 2012; 51: 501–503.
11. Delasotta LA, Hansen R-H and Sands AK. Surgical management of the posterior fibula fracture dislocation: case report. *Foot Ankle Int* 2013; 34: 1443–1446.
12. Hasler J, Antoniadis A, Gkagkalis G, et al. The irreducible ankle dislocation: beware of the Bosworth injury. *Unfallchirurg* 2019; 122(12): 992–996.
13. Ren W, Hu YC and Lu JK. Rare variants of Bosworth fracture-dislocation: Bosworth fracture-dislocation with medial malleolus adduction type fracture. *Chin J Traumatol* 2019; 22(2): 120–124.
14. Moerenhout K, Gkagkalis G, Baalbaki R, et al. Association of Bosworth, pilon, and open talus fractures: a very unusual ankle trauma. *Case Rep Orthop* 2019; 2019: 6316137.
15. Ferris B. Bosworth fracture-dislocation and resultant compartment syndrome. *J Bone Joint Surg Am 2004*; 86: 2571-2572; author reply 2572.
16. Williams AD, Blue M, Douthit C, et al. Bosworth dislocation without associated fracture. *Case Rep Orthop* 2018; 2018: 7284643.
17. Saraiva D, Pereira R, Sarmento A, et al. Ankle arthroscopy in treatment of Bosworth fracture. *Acta Ortop Mex* 2016; 30(5): 251–255.
18. Chan KB and Lui TH. Role of ankle arthroscopy in management of acute ankle fracture. *Arthroscopy* 2016; 32: 2373–2380.