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Prognostic factors for intermediate-term clinical outcomes following Bosworth fractures of the ankle joint

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ABSTRACT

Background: This retrospective comparative study was performed to evaluate the clinical outcomes after surgical treatment for Bosworth fracture-dislocation, and to analyse the prognostic factors related to postoperative outcomes.
Methods: Fifteen patients were followed for ≥2 years after Bosworth fracture-dislocation. Twenty-five ankle fracture-dislocations as control group were enrolled to compare clinical outcomes. Clinical evaluation consisted of the AOFAS and Olerud–Molander scores. Patient and injury factors were analysed to identify the outcome predictors.
Results: There were no significant differences in either clinical evaluation score as compared to control group ($P = 0.245$, .302, respectively). The time interval to operation and number of manual reduction attempts were found to be predictive factors for poor outcomes ($P = 0.004$, .038, respectively).
Conclusion: As compared to more common patterns of ankle fracture-dislocations, intermediate-term clinical outcomes after Bosworth fracture-dislocations were statistically comparable. Delayed surgical reduction and repeated attempts at closed reduction appear to be negative outcome predictors.

1. Introduction

The Bosworth injury is defined as fracture-dislocation of the ankle with fixed displacement of the proximal fragment of the distal fibular fracture behind the posterior tibial tubercle (Fig. 1). The current generally accepted mechanism of injury has been known to be a twisting (external rotation injury) of the foot which mainly results in Danis–Weber type B and Lauge–Hansen supination-external rotation (SER) type fractures [1–3]. The Bosworth fracture-dislocation is usually not reducible using closed methods [4]. Repeated trials of manual reduction can induce additional damage to the soft tissue and articular cartilage, and unnecessary discomfort to patients [5,6]. However, diagnosis of the Bosworth fracture-dislocation is often delayed or missed in the emergency department, owing to its rare occurrence and resulting low suspicion of this ankle fracture pattern [7,8]. This variant of ankle fracture was frequently not recognized on initial radiographs in our institute until the computed tomogram (CT) was obtained (Fig. 2).

As compared to more common ankle fracture-dislocation patterns, the Bosworth fracture-dislocation may more frequently lead to devastating complications such as compartment syndrome [4], neurovascular injury, avascular necrosis of the talus [9], joint stiffness (post-traumatic adhesive capsulitis) [10], and subsequent osteoarthritis [6,7,10]. The clinical results and complications following the Bosworth injury has been reported in the literature as case reports or small case series. However, no study has reported the clinical outcomes of Bosworth fracture-dislocation in comparison to more common ankle fracture-dislocation patterns. In addition, few studies have been published describing the prognostic factors associated with the postoperative outcomes after surgical treatment for Bosworth fracture-dislocation. The purpose of this study was to evaluate the clinical outcomes over intermediate-term followup after surgical treatment for Bosworth fracture-dislocation, and to analyse the prognostic factors related to postoperative outcomes. We hypothesized that the clinical outcomes following Bosworth fracture-dislocation would be inferior as compared to more common patterns of ankle fracture-dislocation.

2. Patients and methods

2.1. Study subjects

Between April 2007 and August 2014, 16 patients that underwent the anatomic reduction and internal fixation for a Bosworth fracture-dislocation were included in the present study.

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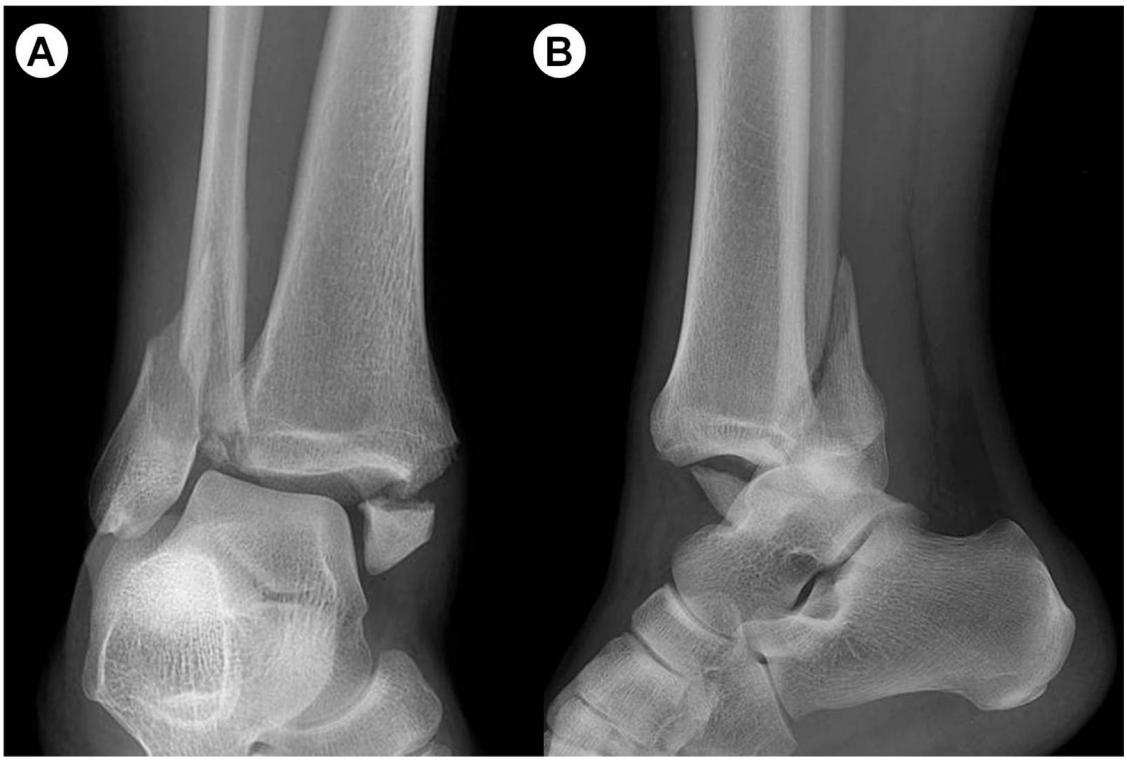

Fig. 1. (A–B) Preoperative radiographs show a displaced oblique Weber type-B bimalleolar fracture with a tibiotalar dislocation.

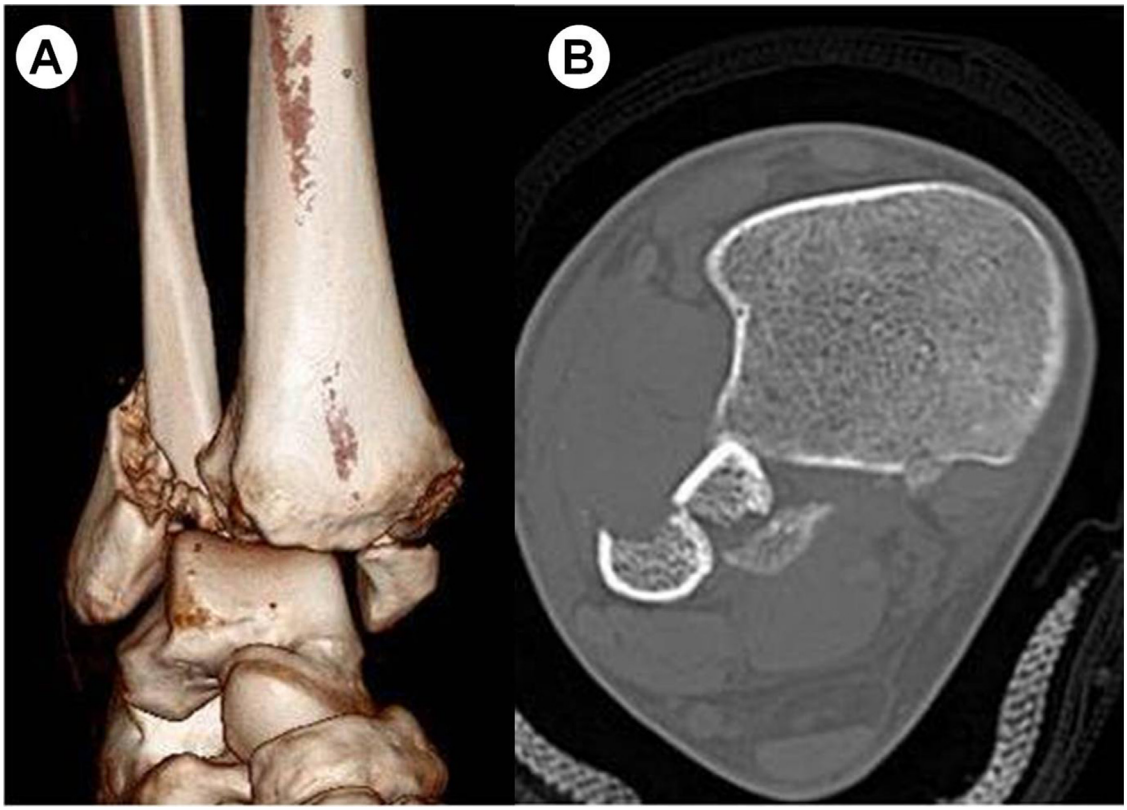

Fig. 2. (A–B) Preoperative CT scans demonstrate the fibula locked behind the posterior tibial tubercle and the empty fibular sulcus.

Fifteen of these patients were followed for more than 2 years postoperatively and constituted the final study cohort. To compare objectively the postoperative clinical and radiological outcomes, 25 ankle fracture-dislocations were enrolled as an age and gender matched control group (Table 1). Inclusion criteria for the control group was patients with unilateral bimalleolar or trimalleolar ankle fracture-dislocation who underwent open reduction and internal fixation including a syndesmotic screw. All operations

Table 1
Characteristics of the control group included in the current study.

		N (25)
Age (mean)	43.2 ± 15.3 years	
Gender	Male	18
	Female	7
Length of followup (mean)	66.1 ± 28.8 months	
Smoking history (within recent 3 years)	Yes	8
	No	17
Diabetes	Yes	4
	No	21
Side of fracture	Right	13
	Left	12
Cause of injury	Slip and fall	15
	Exercise-associated	8
	Traffic accident	2
Skin	Open fracture	3
	Close fracture	22
Fracture pattern	Bimalleolar	8
	Trimalleolar	17
Type of fibular fracture	Danis–Weber B	21
	Danis–Weber C	4
Interval to operation (mean)	22.1 ± 8.4 h	
Fixation method	One third plate	10
	Locking plate	15

were performed by one senior surgeon at a level-1 trauma centre. This study was performed through a retrospective evaluation of prospectively acquired data. The study protocol and investigation were conducted with Institutional Review Board approval, and written informed consent was obtained.

At the time of surgery, mean patient age was 42.6 years (range, 21–57 years), and mean length of followup was 60.3 months (range, 24–109 months). Patients included 11 males (73.3%) and 4 females (26.7%), with 9 right-sided (60%) and 6 left-sided procedures (40%). The causes of injury included 7 cases of slip and fall injuries, 6 cases of exercise-associated injuries, and 2 cases of traffic accidents. With respect to the fracture patterns based on the Lauge–Hansen and Danis–Weber classifications, there were 13 patients with supination-external rotation type (Danis–Weber B) and 2 with pronation-external rotation type (Danis–Weber C). All patients except for 2 cases had associated medial malleolar fractures. The posterior malleolar fractures were found in 9 patients. An avulsion fragment associated with the anterior tibiofibular ligament was found in 3 patients. Two out of the 15 patients had open fractures (types I and II according to the Gustilo–Anderson classification). Eight patients underwent primary examination and treatment including at least one manual reduction attempt in the emergency department of our institution, and 7 patients were transferred from other hospitals after failed reduction attempts. Surgical reduction was performed as soon as possible after confirmation of the Bosworth fracture-dislocation. Mean interval to operation from injury was 29.6 h (range, 10–52 h).

2.2. Surgical procedures

Surgical procedures consisted of a open release of the locked proximal fibular shaft from the posterior tubercle using a Hohmann retractor (Fig. 3), reduction of the lateral malleolar fracture and internal fixation with a plate and 3.5-mm lag screw, reduction of the medial malleolar fracture and internal fixation using two 4.0-mm cancellous screws or tension-band wiring with k-wires, and stabilization of the tibiofibular syndesmosis based on the result of the Cotton test (medial clear space widening $\geq$4 mm or tibiofibular overlap $\leq$8 mm). A conventional one-third tubular plate was used in 7 cases and a locking compression plate in 8 cases (Fig. 4). Syndesmotic diastasis was stabilized with a transverse 3.5-mm cortical screw (place with fixation across three cortices without compression) in 12 cases. In the present study, there was no case with posterior malleolar fracture (fragment with articular surface involvement $\geq$20%) which was large enough to require surgical reduction and internal fixation.

A short leg splint and non-weight bearing ambulation with crutches were maintained for 2 weeks. A short leg cast was discontinued at 6 weeks postoperatively. Thereafter, active and passive range of motion (ROM) exercises, and partial-weight bearing ambulation with an ankle brace were encouraged. Syndesmotic screws were removed between 12–16 weeks after surgery. Full-weight bearing and return to normal activity level were permitted after the signs of clinical and radiologic union were identified.

2.3. Clinical and radiological assessment

Clinical evaluation tools consisted of the American Orthopaedic Foot and Ankle Society (AOFAS) score, and Olerud–Molander score. The AOFAS ankle-hindfoot rating score [11] is a 100-point physician-based scale comprised of three subcomponents: pain (40 ponits), alignment (15 points), and function (45 points). The Olerud–Molander score [12] includes subcomponents more focused on functional assessment: pain (25 ponits), swelling (10 points), and function (65 points). These scores were measured at final followup visit. ROM of the ankle joint was measured using a goniometer by a corresponding author at final followup.

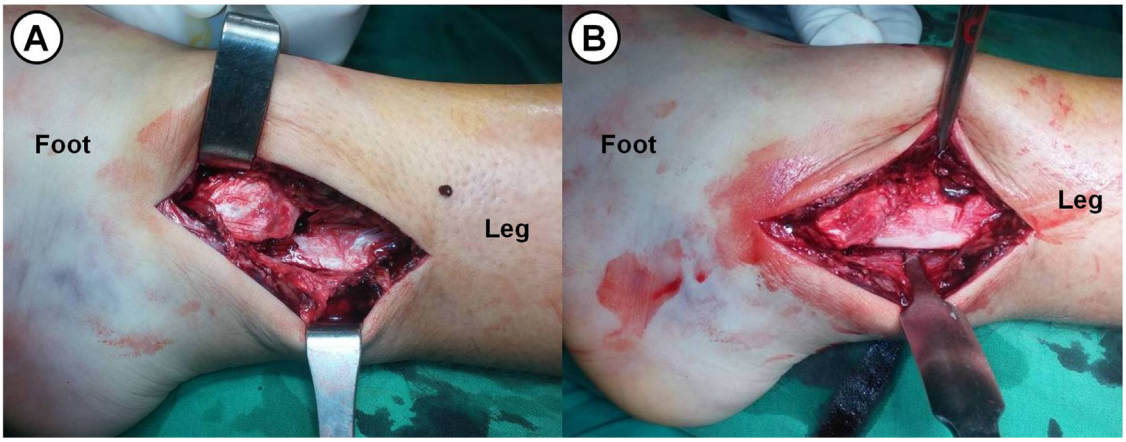

Fig. 3. Intraoperative photographs show (A) a proximal fibular shaft fragment trapped behind the posterior tibial tubercle, (B) a open release of the locked proximal fragment using a Hohmann retractor.

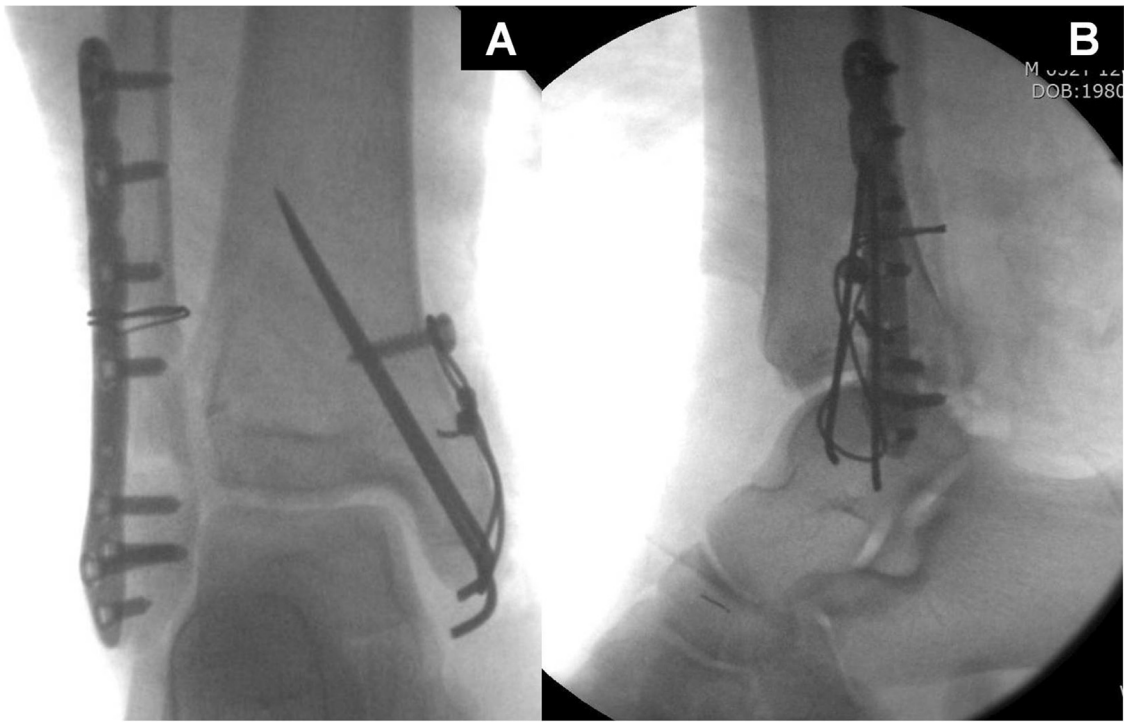

Fig. 4. (A–B) Postoperative radiographs show the normal alignment of the ankle mortise following open reduction and internal fixation.

Radiographic measurement to evaluate a restoration of the ankle mortise included medial clear space, tibiofibular overlap and tibiofibular interval at final followup. Reduction of the tibiofibular syndesmosis was evaluated on CT axial scan at final followup. In the present study, a syndesmotic malreduction was defined as the fibular displacement $\geq$3 mm. All measurements were independently performed using a picture archiving and communication system (PACS) by 3 orthopaedic surgeons. Measures were repeated twice, and subsequently averaged. Osteoarthritis of the ankle was evaluated using the Takakura classification [13] on standing radiographs. In the present study, posttraumatic osteoarthritis was defined as patients either stage 2 with medial clear space $\leq$2 mm, stage 3, or stage 4.

2.4. Analysis of the prognostic factors

To determine the patient and injury factors associated with the clinical outcomes following the Bosworth fracture-dislocation, a total of 11 prognostic factors were categorized as dichotomous variables and analysed: the age of patients, gender, smoking history, medical history of diabetes, number of manual reduction attempts, time interval to operation, presence of posterior malleolar fracture [14], presence of anterior tibiofibular ligament (ATFL) avulsion fragment [15], the pattern of fibular fracture, fixation method, and operative time.

2.5. Statistical analysis

The statistical analysis was performed using SPSS (version 20.0; SPSS Inc, Chicago, IL, USA), and P values <0.05 were considered statistically significant. The clinical and radiological outcomes at final followup were compared to the control group using Mann–Whitney and Fisher's exact test. Statistical associations between the clinical outcomes and patient and injury factors were examined in univariate analysis. Logistic regression analysis (stepwise forward with an inclusion level of 5%) was performed using the variables that showed significant association in univariate test.

3. Results

Three out of the 8 patients that underwent primary examination in emergency department of our institute were diagnosed to the Bosworth fracture-dislocation through initial radiographs, and a manual reduction by orthopaedic surgeon was performed only once. The other 5 patients were misdiagnosed as a common ankle fracture-dislocation on initial radiographs, and an average of 2.2 (range, 1–3 times) manual reductions were attempted prior to CT scans being obtained. Only two out of the 7 patients from other hospitals after failed reduction were transferred with the diagnosis of the Bosworth fracture-dislocation. These 7 patients underwent an average of 2.8 (range, 2–4 times) manual reduction attempts in the outside hospitals, and no additional reduction attempts were performed in our institute. The average number of manual reduction attempts in the sample of 15 patients was 2.24 attempts. Only 1 patient achieved a successful reduction with closed method.

Mean AOFAS and Olerud–Molander scores were 87.8 (range, 74–100 points) and 88.4 points (range, 76–98 points) at final followup, respectively. There were no statistically significant differences in either of these clinical evaluation scores compared to the control group (P = 0.245, .302, respectively) (Table 2). Mean active dorsiflexion, plantarflexion, inversion, eversion of the ankle joint were 15.2° (range, 5–20°), 36.2° (range, 20–40°), 27.8° (range, 10–35°), 19.5° (range, 5–25°) at final followup, respectively. There were no statistically significant differences in postoperative ROM between the 2 groups (P > 0.05). Joint stiffness <30° in dorsiflexion–plantarflexion arc was found in 2 patients (13.3%) in the Bosworth group and 3 patients (12%) of control group (P = 0.887). Postoperative skin necrosis and compartment syndrome occurred only in the Bosworth group, but the power of the statistical test was insufficient due to a limited sample size. The frequency of postoperative wound infection or nonunion was statistically similar (P = 0.903, 1, respectively).

Radiographic evaluation at final followup revealed that there were no statistically significant differences in alignment of the ankle mortise between the two groups (P > 0.05) (Table 3). In addition,

Table 2
Comparison of clinical outcomes with control group at final followup (Mann–Whitney and Fisher's exact test).

Clinical evaluation	Bosworth group[a] (n = 15)	Control group[a] (n = 25)	P-value
AOFAS score	87.8 ± 11.7	89.1 ± 10.2	0.245
Olerud–Molander score	88.4 ± 10.8	89.8 ± 9.6	0.302
Active dorsiflexion (°)	15.2 ± 4.6	16.8 ± 2.4	0.231
Active plantarflexion (°)	36.2 ± 3.2	36.9 ± 2.8	0.925
Active inversion (°)	27.8 ± 4.4	29.6 ± 4.1	0.184
Active eversion (°)	19.5 ± 3.9	20.6 ± 3.8	0.408
Ankle stiffness (n)	2 (13.3%)	3 (12%)	0.887
Nonunion (n)	0 (0%)	0 (0%)	1
Wound infection (n)	1 (6.7%)	2 (8%)	0.903
Skin necrosis (n)	1 (6.7%)	0 (0%)	Not applicable
Compartment syndrome (n)	1 (6.7%)	0 (0%)	Not applicable

[a] The values are given as the mean with standard deviation.

Table 3
Comparison of radiological outcomes with control group at final followup (Mann–Whitney and Fisher's exact test).

Radiological evaluation	Bosworth group[a] (n = 15)	Control group[a] (n = 25)	P-value
Period to union (weeks)	13.5 ± 3.2	13.7 ± 3.3	0.952
Displacement of fibula (mm)	1.8 ± 0.8	1.4 ± 0.6	0.323
Medial clear space (mm)	2.8 ± 0.8	3.1 ± 0.9	0.531
Tibiofibular overlap (mm)	9.1 ± 2.2	8.8 ± 2.3	0.906
Tibiofibular interval (mm)	2.7 ± 1.1	2.9 ± 1.2	0.889
Takakura classification (stage)	1.7 ± 0.6	1.4 ± 0.5	0.182
Syndesmotic malreduction (n)	2 (13.3%)	3 (12%)	0.819
Posttraumatic osteoarthritis (n)	3 (20%)	4 (16%)	0.288

[a] The values are given as the mean with standard deviation.

Table 4
Side to side comparison regarding the alignment of the ankle mortise at final followup (Mann–Whitney test).

Radiological evaluation	Injured side[a] (n = 15)	Uninjured side[a] (n = 15)	P-value
Medial clear space (mm)	2.8 ± 0.8	2.9 ± 0.6	0.958
Tibiofibular overlap (mm)	9.1 ± 2.2	9.8 ± 1.9	0.225
Tibiofibular interval (mm)	2.7 ± 1.1	2.3 ± 0.5	0.134

[a] The values are given as the mean with standard deviation.

postoperative side to side comparison regarding the alignment of the ankle mortise showed no significant differences between the injured and uninjured ankles ($P > 0.05$) (Table 4). All patients in the Bosworth group achieved a complete union at an average of 13.5 weeks, and there was no significant difference from control group ($P = 0.952$). On CT scan at final followup, syndesmotic malreductions (fibular displacement $\geq$3 mm) were found in 2 patients (13.3%) in the Bosworth group and 3 patients (12%) in the control group ($P = 0.819$). Mean Takakura stage at final followup was 1.7 and showed no significant difference with the control group ($P = 0.182$). Posttraumatic osteoarthritis of the ankle occurred more frequently in the Bosworth group (20%) than the control group (16%), but this difference was not statistically significant ($P = 0.288$). The reliability (intraobserver reproducibility and interobserver agreement) for radiographic measurement at final followup was evaluated to be excellent or good (Table 5).

Table 5
Analysis of inter- and intraobserver reliability for radiographic measurement at final followup.

Variables	Intraclass correlation coefficient (95% CI[a])	
	Intraobserver	Interobserver
Medial clear space	0.895 (0.821–0.942)	0.836 (0.749–0.892)
Tibiofibular overlap	0.793 (0.698–0.865)	0.724 (0.603–0.811)
Tibiofibular interval	0.804 (0.706–0.883)	0.759 (0.646–0.838)
Displacement of fibula	0.832 (0.738–0.904)	0.786 (0.683–0.851)
Takakura classification	0.931 (0.864–0.973)	0.922 (0.855–0.958)

[a] CI, confidence interval.

Mean AOFAS and Olerud–Molander scores were significantly higher in patients who underwent 1 or 2 manual reduction attempts than those with 3 or greater reduction attempts ($P = 0.014$, 0.029, respectively) (Table 6). Patients who underwent surgical treatment within 24 h after injury showed significantly higher AOFAS and Olerud–Molander scores than those whose surgery was delayed beyond 24 h ($P = 0.002$, .041, respectively). No other factors were found to be significantly associated with the AOFAS or Olerud–Molander scores.

In logistic regression analysis, increasing time interval to operation and repeated manual reduction attempts were found to be the statistically significant predictive factors for poor clinical outcomes in the Bosworth fracture-dislocation ($P = 0.004$, .038, regression coefficient = −0.0571, −0.0393, respectively).

4. Discussion

The most important finding of this study was that the intermediate-term clinical outcomes after surgical treatment for the Bosworth fracture-dislocations were statistically comparable to more common patterns of ankle fracture-dislocations. In addition, delayed surgical reduction and repeated attempt of closed reduction appear to be prognostic factors for poorer clinical outcomes.

The limitations of our study are as follows. First, this study was retrospective and contained biases less likely to occur in a prospective study. Second, power of the statistical test was insufficient due to a limited sample size in the Bosworth group.

Table 6
Univariate analysis of the prognostic factors affecting the clinical outcomes.

Variables		AOFAS score[a]	P-value[b]	Olerud–M score[a]	P-value[c]
Age of patients	≤40 years (n = 8)	89.1 ± 9.6	0.735	90.7 ± 8.3	0.228
	>40 years (n = 7)	86.5 ± 10.4		86.1 ± 10.2	
Gender	Male (n = 11)	88.4 ± 9.1	0.886	87.9 ± 9.8	0.931
	Female (n = 4)	87.2 ± 9.8		88.9 ± 9.3	
Smoking history (within recent 3 years)	Yes (n = 5)	87.1 ± 10.2	0.822	87.7 ± 9.8	0.847
	No (n = 10)	88.5 ± 9.6		89.1 ± 8.5	
Diabetes	Yes (n = 2)	87.3 ± 9.5	0.895	87.6 ± 9.7	0.792
	No (n = 13)	88.3 ± 8.9		89.2 ± 8.8	
Manual reduction trial	1 time (n = 4)	91.2 ± 7.5	0.014	91.7 ± 8.1	0.029
	2 times (n = 4)	89.5 ± 9.1		90.2 ± 8.7	
	≥3 times (n = 7)	82.7 ± 10.3		83.3 ± 9.8	
Fixation method	One third plate (n = 7)	88.1 ± 9.2	0.941	88.5 ± 8.9	0.985
	Locking plate (n = 8)	87.5 ± 10.4		88.3 ± 9.1	
Interval to operation	≤24 h (n = 7)	93.1 ± 6.8	0.002	92.8 ± 7.1	0.041
	>24 h (n = 8)	82.5 ± 12.9		84.0 ± 11.8	
Posterior malleolar Fx	Yes (n = 9)	86.5 ± 11.3	0.613	87.3 ± 10.4	0.726
	No (n = 6)	89.1 ± 7.9		89.5 ± 7.8	
ATFL avulsion Fx	Yes (n = 3)	88.3 ± 7.8	0.902	88.8 ± 7.5	0.928
	No (n = 12)	87.3 ± 9.6		88.0 ± 8.1	
Pattern of fibular Fx	Danis–W B (n = 13)	88.2 ± 8.4	0.915	89.0 ± 7.8	0.854
	Danis–W C (n = 2)	87.4 ± 8.9		87.8 ± 8.6	
Operation time	≤80 min (n = 8)	87.5 ± 9.1	0.932	88.9 ± 8.2	0.881
	>80 min (n = 7)	88.1 ± 8.8		87.9 ± 9.7	

Abbreviations: AOFAS, American Orthopaedic Foot & Ankle Society; ATFL, Anterior Talofibular Ligament; Fx, fracture; Olerud–M, Olerud–Molander; Danis–W, Danis–Weber.
[a] The values are given as the mean with standard deviation.
[b] Comparison of AOFAS scores at final followup (Mann–Whitney and ANOVA test).
[c] Comparison of Olerud–Molander scores at final followup (Mann–Whitney and ANOVA test).

This may account for the lack of association in this study between clinical outcomes and patient risk factors such as age, gender, and diabetes shown in prior studies to be associated with functional outcomes after ankle fracture surgery [16]. A prospective comparative study with statistically sufficient power would be needed to further define risk factors associated with complications following the Bosworth fracture-dislocation. Third, clinical evaluation tools (the AOFAS and Olerud–Molander scores) are not validated for the ankle fractures. Fourth, an identification of the actual status of the articular cartilage was limited because osteoarthritis of the ankle was evaluated with only standing radiographs. This study included no followup examination with MRI or second-look arthroscopy. Lui et al. [17] have reported that osteochondral lesions were present in three out of four patient with the Bosworth fracture-dislocation, and ankle degeneration developed in all three patients. Arthroscopic examination concomitant with implant removal around 1 year postoperatively was suggested by the corresponding author, but many patients refused an arthroscopic procedure due to additional medical expense. Fifth, a heterogeneity of the detailed fracture pattern between the cases included in this study can be a possible bias.

The Bosworth fracture-dislocation is an uncommon pattern of ankle fracture and can be subject to delay in diagnosis in many cases. The characteristic radiographic appearances include a widened medial joint space, overlap of the proximal fibular fragment and the distal tibia on the anteroposterior view (increased tibiofibular overlap), and posterior displacement of the fibula on the lateral view [3,6]. Yang et al. [5] have reported the usefulness of an external oblique ankle radiograph for diagnosis of Bosworth-type fracture, which shows the position of the fibular shaft relative to the talus. As a useful indicator of Bosworth fracture on standard radiographs, Khan and Borton [18] have introduced the axilla sign which means a cortical radiodensity of the medial tibial plafond due to persistent internal rotation of the tibia. Although there may be controversy on cost-effectiveness, the routine use of CT scan is also recommended to avoid the difficulties of managing this challenging fracture configuration [3,6,18]. The management of ankle fracture-dislocations in our institution has been changed to permit the routine use of CT scan, with only one attempt at manual reduction before CT scan is obtained.

In the current study, 5 out of the 8 patients presented in our institute were initially diagnosed as common ankle fracture-dislocations on initial radiographs, and an average of 2.2 manual reductions with the strong pain-control were attempted prior to CT scans being obtained. Only two out of the 7 patients from other hospitals were transferred with the diagnosis of the Bosworth fracture-dislocation. These 7 patients underwent an average of 2.8 manual reduction attempts in the outside hospitals. Although surgical reduction was performed as soon as possible without additional attempt for closed reduction after confirmation of the Bosworth fracture-dislocation, the primary management in our emergency department were considered to be unsatisfactory. Mean interval to operation from injury was 29.6 h. There were many variables which influenced the interval to operation from injury; difference in the awareness of the Bosworth fracture-dislocation between primary physicians, strict preoperative work-up by anaesthesia department, fast for at least 8 h to undergo spinal anaesthesia, limited number of available operation room at night, mandatory consent for operation from a family member, et al. In addition, the transfer from other hospitals after failed reduction attempts or delayed diagnosis was responsible for long time to operation from injury. A large portion of above-mentioned variables can be improved through more comprehension in regard to this unusual injury and changes in condition of medical treatment.

The Bosworth fracture-dislocation is typically not reducible using closed methods because the fibular shaft fragment becomes incarcerated on the osseous posterolateral ridge of the distal tibia [4,19,20]. Delayed reduction of the ankle joint can result in severe joint stiffness and the Bosworth fracture-dislocation may be at higher risk due to significant soft tissue injury around the ankle. Lui et al. [17] have reported that patients with delayed reduction suffered from posttraumatic ankle stiffness and subsequently developed ankle degeneration. In contrast, Bartonicek et al. [7] have reported that delayed open reduction and internal fixation

does not necessarily lead to a poor outcome if careful management of soft-tissue swelling is maintained. In the current study, 2 patients with joint stiffness <30° in dorsiflexion–plantarflexion arc underwent surgical reduction at 43 and 52 h after injury, respectively. The number of manual reduction attempts were four and three, respectively. Both the time interval to operation and number of reduction attempts in theses two patients were higher than average values for the sample (29.6 h and 2.24 times) in this study. Earlier recognition of this type of irreducible fracture-dislocation can contribute to the elimination of repeated reduction attempts.

The previously reported complications following Bosworth fracture-dislocations include skin necrosis, wound infection, stiffness of the ankle or subtalar joint, avascular necrosis of the talus, compartment syndrome, damage to the superficial peroneal nerve, and subsequent osteoarthritis [4,6,7,9,10,15,21]. Although various complications related to the Bosworth injury have been reported, it remains unclear whether Bosworth fracture-dislocations have a higher risk of complications than other ankle fracture-dislocations. In addition, no study has reported the long-term clinical outcomes of Bosworth fracture-dislocation in comparison to more common ankle fracture patterns. There are a few reported cases of compartment syndrome after ankle fractures, and the deep posterior compartment is commonly involved [4]. Bartonicek et al. [7] reported that 5 (8.5%) out of the 59 patients developed compartment syndrome and indicated the susceptibility of the Bosworth lesion to this complication.

Because the correct diagnosis depends on careful evaluation of the initial clinical and radiographic features, the awareness of this rare ankle fracture variant is essential to avoid repeated reduction attempts and delayed surgical treatment [8]. Early recognition and prompt surgical reduction for this irreducible fracture is known to be important to prevent early and late morbidities [5,6,17]. Therefore, further education and enlightenment could improve the patient management of this uncommon injury.

5. Conclusions

When compared to more common patterns of ankle fracture-dislocations, the intermediate-term clinical outcomes after surgical treatment for the Bosworth fracture-dislocations were statistically similar. Delayed surgical reduction and repeated attempts at closed reduction appear to be prognostic factors for poorer outcomes.

Conflict of interest statement

The authors have no conflict of interest to report and have received no financial support for the completion of this work

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