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A Two-Stage Protocol With Vacuum Sealing Drainage for the Treatment of Type C Pilon Fractures

Zhenhai Wang, PhD [1], Wenqing Qu, BSc [2], Tong Liu, BSc [2], Zhiyong Zhou, BSc [2], Zhongyuan Zhao, BSc [2], Dan Wang, BSc [2], Limin Cheng, MD [1]

[1] *Orthopaedist, Department of Orthopaedic and Trauma, Yantaishan Hospital; and Orthopaedist, Department of Orthopaedic and Trauma, Yantai Sino-French Friendship Hospital, Yantai, People's Republic of China*

[2] *Surgeon, Department of Orthopaedic and Trauma, Yantaishan Hospital; and Surgeon, Department of Orthopaedic and Trauma, Yantai Sino-French Friendship Hospital, Yantai, People's Republic of China*

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ABSTRACT

Management of type C pilon fractures remains controversial and challenging. The aim of the present study was to provide a 2-stage protocol with vacuum sealing drainage for the treatment of type C pilon fractures. From March 2009 to March 2012, 16 patients (mean age 42.3 years) were admitted to our department with type C pilon fractures and treated with single-stage external fixation and second-stage internal fixation (anteromedial incision) combined with vacuum sealing drainage. The American Orthopaedic Foot and Ankle Society scale score averaged 86.5 for this group of patients. The range of motion was 30° ± 8.9°. An excellent or good American Orthopaedic Foot and Ankle Society scale score was obtained for all patients. None of the 16 patients developed skin necrosis, nonunion, or fixation failure during the follow-up period. Moreover, the visual analog scale pain scores were 0.7 ± 0.8, 0.9 ± 0.7, and 1.4 ± 1.0 during rest, active movement, and weightbearing, respectively. The postoperative radiographs showed excellent treatment effects. A 2-stage protocol, combined with vacuum sealing drainage, for the treatment of type C pilon fractures can eliminate deep infection and complex surgery and is a simple and effective treatment method. In addition, full exposure of the anteromedial incision, the avoidance of the anterior tibial muscle tendon sheath, and the avoidance of soft tissue injuries are generally recommended in this operation.

Tibial pilon fractures represent 1% to 10% of all fractures of the lower extremity. These fractures have been consistently challenging to treat as evidenced by the high rates of wound complications. Of these, Arbeitsgemeinschaft für Osteosynthesefragen/Orthopedic Trauma Association (AO/OTA) type C pilon fractures are the most complex type of pilon fracture. These usually result from high-energy trauma and are often associated with the presence of articular comminution, severe soft tissue injury, and impaction of the articular surface of variable segments into the overlying tibial metaphysic. To date, type C tibial pilon fractures remain therapeutically challenging even for experienced orthopedic surgeons. For example, treatment of type C pilon fractures by internal fixation has been associated with a relatively high postoperative complication rate and poorer outcomes compared with treatment of other tibial pilon fractures (1,2). Recently, the method of external fixation, combined with internal fixation, has produced challenging results; however, metallic implants can cause negative symptoms and necessitate unplanned surgery for removal, which consumes healthcare resources, can cause complications, and can be regarded as uneconomic (3,4). In contrast, although lower profile metallic implants have significantly reduced the incidence of soft tissue complications, cases of implant-related soft tissue problems still occur (5). Taken together, the treatment of type C pilon fractures remains controversial and challenging.

Vacuum sealing drainage (VSD) is a novel and efficient drainage system. Its efficiency is embodied by its comprehensive and thorough drainage under high vacuum. VSD has become the standard method for treating various types of wound surfaces and wounds that are difficult to heal. A large number of animal experiments and clinical trials have indicated that VSD is a better, safer, and more effective method, with a low infection rate, for treating open fractures (6,7). However, to date, few studies have reported on the use of VSD in type C pilon fractures.

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Address correspondence to: Zhenhai Wang, PhD, Department of Orthopaedic and Trauma, Yantaishan Hospital, Yantai Sino-French Friendship Hospital, Yantai 264000, People's Republic of China.

E-mail address: ytzhenhai@163.com (Z. Wang).

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Table
Detailed patient data

Patient No.	Gender/Age (y)	Etiology	AO Type	Associated Injuries	Interval* (d)
1	M/38	MVA	C3	LMF	11
2	M/42	MVA	C3	LMF	12
3	F/37	MVA	C1	None	11
4	M/51	MVA	C2	LMF	13
5	M/56	FFH	C3	LMF	14
6	F/50	MVA	C2	LMF	15
7	M/35	FFH	C3	LMF	12
8	M/28	MVA	C3	LMF, WMMF	19
9	M/32	FFH	C2	None	11
10	M/38	MVA	C2	LMF	11
11	M/41	FFH	C3	LMF, WMMF	18
12	M/43	FOS	C3	None	11
13	M/55	MVA	C3	LMF	15
14	M/53	FFH	C3	LMF	13
15	M/56	FOS	C2	LMF	15
16	M/50	FFH	C3	LMF	12

Abbreviations: F, female; FFH, fall from height; FOS, fall on stairs; LMF, lateral malleolar fracture; M, male; MVA, motor vehicle accident; WMMF, whole medial malleolar fracture.
* Interval between first- and second-stage operation.

In the present study, type C tibial pilon fractures were treated with single-stage external fixation and second-stage internal fixation (anteromedial incision) combined with VSD. Our results will provide guidance for clinical surgery to treat type C tibial pilon fractures.

Patients and Methods

The local institutional review board provided ethics permission for the present study. From March 2009 to March 2012, 16 patients with type C pilon fractures were treated with single-stage external fixation and second-stage internal fixation combined with VSD. The inclusion criteria consisted of a displaced and comminuted AO/OTA type C pilon fracture and a skeletally mature patient. Of the 16 patients, 14 were male and 2 were female, with a mean age of 42.3 (range 28 to 56) years. Detailed patient data are listed in the Table.

The cause of injury was high-energy trauma in all 16 patients, including a fall from a height in 6, road accidents in 8, and a sprain in 2. According to the Osteosynthesis/Association for the Study of Internal Fixation system, of the 16 fractures, 1 (6%) was a type C1 fracture, 5 (31%) were type C2 fractures, and 10 were (63%) type C3 fractures. Of the 16 patients, 13 (81%) had associated injuries, including a lateral malleolar fracture in 13 and a whole medial malleolar fracture in 2. After admission, the assessment, evaluation, and surgery were performed by orthopedists of the same surgical team using a 2-stage protocol.

A lateral incision was performed at shank, and the fibula was exposed, with avoidance of superficial peroneal nerve. An AO reconstructive plate or a plus one-third tube plate were placed in all cases after fracture reduction. The proximal pins were inserted into the bone fracture, the 2 distal pins were inserted into the metatarsals and calcaneus respectively, with a triangle formed by the 3 pins (Fig. 1). The second-stage operation was performed after the subsidence of swelling, healing of any open wound, and/or re-epithelialization of any fracture blisters. The operation was performed with the patient under spinal anesthesia. An anteromedial incision was performed from the lateral tibial crest to the first metatarsal bones by way of the middle of the ankle joint (Fig. 1). After excision of the superficial fascia, the deep fascia were exposed and dissected at the anterior crest of the tibia. Next, the distal extensor retinaculum was dissociated, with avoidance of the anterior tibial muscle tendon sheath (Fig. 2).

During the reconstructive surgeries, the hock and fragments of the compression fracture were reduced and provisionally stabilized using Kirschner wires. Using C-arm computed tomography scanning and 3-dimensional reconstruction, the reconstructive plate was placed in all cases and the Kirschner wires were entirely removed. After surgery, the incisions were not closed

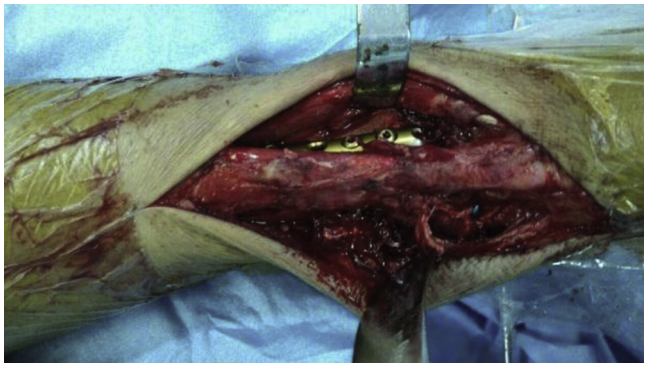

Fig. 2. The anterior tibial muscle tendon sheath should be avoided during the 2-stage operation.

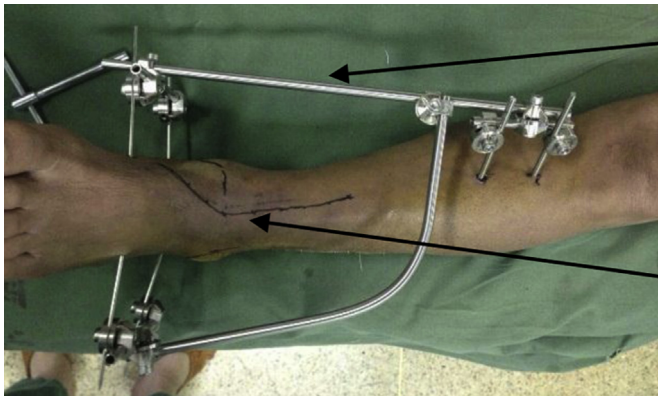

Fig. 1. A triangular external fixator formed by 3 pins was used (*top arrow*), and the anteromedial incision was performed from the lateral tibial crest to the first metatarsal bones by way of the middle of the ankle joint (*bottom arrow*).

Fig. 3. The nylon sutures were prepared on the surfaces and gradually closed after the swelling had subsided.