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Original research

Surgical treatment of pilon fracture based on ankle position at the time of injury/initial direction of fracture displacement: A prospective cohort study

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ABSTRACT

Objective: The purpose of this study is to evaluate a surgical strategy for pilon fractures based on ankle position/initial direction of fracture displacement at the time of injury.
Methods: Sixty-nine patients were categorized into groups based on ankle position at the time of the injury: Group I (varus), Group II (valgus), Group III (dorsiflexion), Group IV (plantarflexion), and Group V (neutral). The American Orthopedic Foot and Ankle Society (AOFAS) score was determined at 12 months.
Results: More than 90% of participants in Groups I–IV as well as 57.2% of participants in Group V had anatomic/good fracture reduction, respectively. Fracture healing/union was significantly slower in Group V vs Groups I, III, and IV, and in Group II vs Group IV ($P < 0.005$). AOFAS scores were significantly higher ($P < 0.005$) in Groups III (96.0, IQR: 90.0–96.0) and IV (95.0, IQR: 90.0–100.0) vs Groups II (86.9, IQR: 75.0–90.0) and V (83.0, IQR: 73.0–86.0). Wound breakdown was the most common complication ($n = 11$).
Conclusions: Determining the surgical strategy for managing pilon fractures based on ankle position at the time of the injury/initial direction of fracture displacement may be effective.

Highlights

What is already known on this topic?

Surgical management of pilon fractures are known to make reconstruction of the fibula and articular surface of tibia, restoration of the joint's mechanical axes, and stabilization of the tibia.

What this study adds?

A surgical strategy based on position of the ankle at the time of injury.

1. Introduction

Pilon fractures are relatively rare, comprising approximately 1% of all lower extremity fractures and 5–10% of tibial fractures [1–4]. These types of fractures can be challenging to treat; hence, determining the best means of surgical management for each patient is critical for optimizing clinical outcomes.

The keys to surgical management of pilon fractures are reconstruction of the fibula and articular surface of tibia, restoration of the joint's mechanical axes, and stabilization of the tibia to help facilitate early postoperative movement [3–5]. Classification of pilon fractures is an important part of surgical planning. Several classification systems exist, of which the Arbeitgemeinschaft fur Osteosynthesefragen (AO)/Orthopedic Trauma Association (OTA) and Ruedi-Allgower systems are commonly used [2,6]. With the AO/OTA scheme, fractures are classified on the degree of articular involvement and comminution and impaction in the metaphysis and epiphysis [7]. Ruedi–Allgower classification divides fractures by the extent of displacement, comminution, and impaction of the fracture fragments [8]. More recently, Topliss et al. described two fracture families based on orientation of the major fracture lines (sagittal and coronal), and suggested that orientation of the major fracture line has important implications for fixation [9].

In our practice, we have observed that pilon fractures appear to have certain characteristics depending on orientation of the ankle at the time of injury (ie, varus, valgus, dorsiflexion, plantarflexion,

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neutral). This led us to hypothesize that the surgical strategy could be determined by the position of the ankle (and hence the initial direction of fracture displacement) at the time of injury, and that such a strategy may minimize soft tissue complications and facilitate reconstruction of the articular surface of the tibia. Herein, we report the results of a prospective study designed to test this hypothesis.

2. Patients and methods

2.1. Patients

Patients who sustained pilon fractures were invited to participate in this prospective study, which took place between June 2008 and June 2012 at a Level 1 trauma center. All participants provided written informed consent. The study was approved by the Ethics Committee of our Hospital.

Patients were eligible for inclusion if they were aged >18 years and had pilon fractures suitable for treatment via open reduction and internal fixation (ORIF) or limited internal fixation with external fixation. Patients were excluded if they had: compartment syndrome; undergone amputation before fracture management; concomitant injuries to the brain, chest, and/or abdomen; a history of peripheral angiopathy and/or arthritis in the injured leg; uncontrolled diabetes (i.e., poorly controlled blood glucose concentrations and/or diabetes-related complications); or pathologic fracture.

Participants were grouped according to ankle position at the time of the injury/initial direction of fracture displacement (determined by X-ray and/or computed tomography). Ankle position at the time of injury was determined according to: the patient's description of posture at the time of injury and the direction of fall; and the initial imaging findings, showing the direction of fracture displacement and tilting of the articular surface. For Group I (varus), the ankle was in a varus position at the time of injury (i.e., the axial force was medially deviated), the medial part of distal tibial articular surface was compressed, and the major fracture fragments were located in the medial aspect, with or without medial talus tilt. For Group II (valgus), the ankle was in a valgus position at the time of injury, the lateral part of distal tibial articular surface was compressed, and the major fracture fragments were located in lateral aspect, with or without lateral talus tilt. For Group III (dorsiflexion), the ankle was in dorsiflexion at the time of injury, the anterior part of distal tibial articular was damaged, and the major fracture fragments were located in the anterior aspect. This type of injury is commonly due to jumping from a height with knee flexion and dorsal flexion of the ankle. For Group IV (plantarflexion), the ankle was in plantarflexion at the time of injury, the posterior part of distal tibial articular surface was damaged, and the major fracture fragments were located in the posterior aspect. This type of injury is

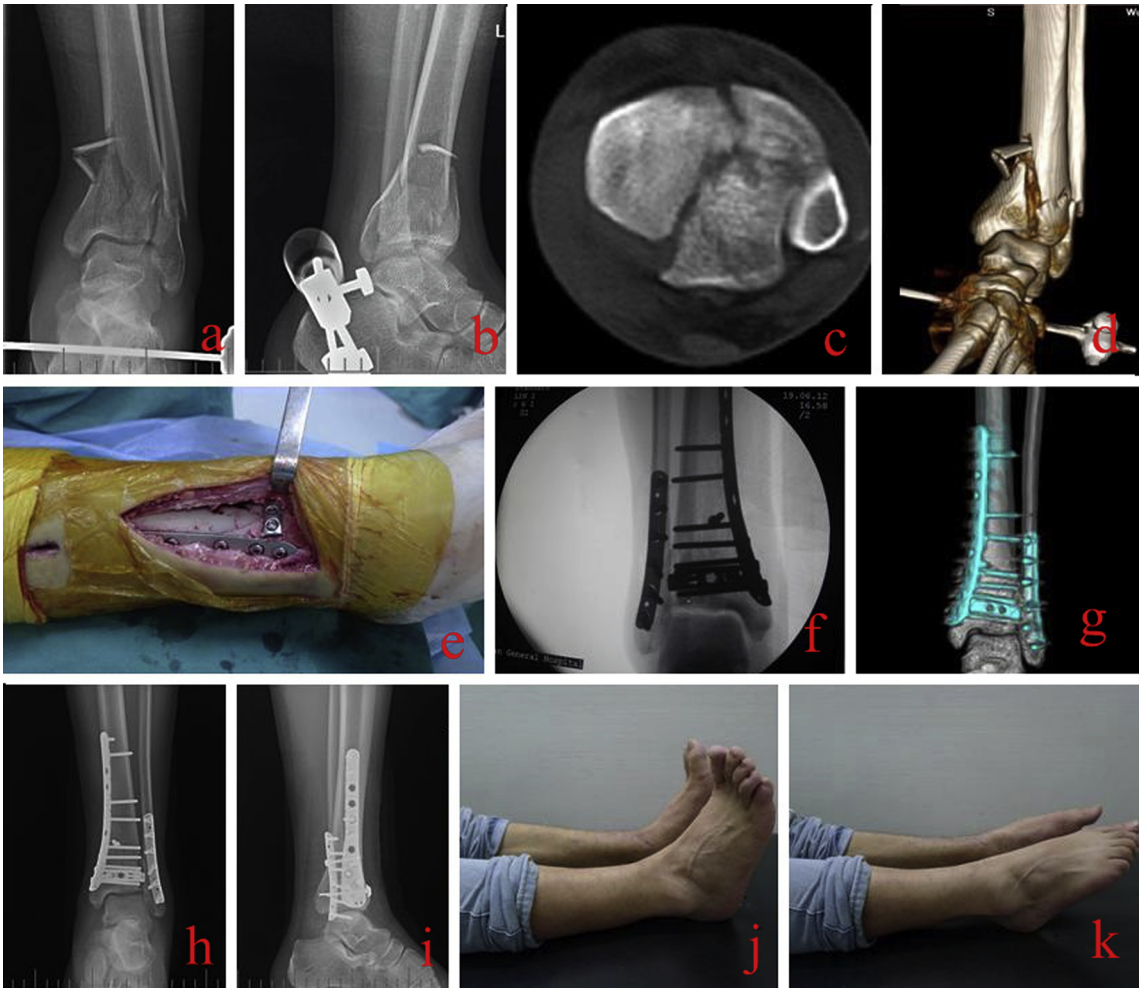

Fig. 1. Radiographs and photographs of a 22-year old male who experienced a pilon fracture (AO/OTA type C2) caused by varus injury (a–d). An anteromedial surgical approach was used: The medial part of articular surface was reduced and a buttress plate was placed on the medial aspect of distal tibia (e–g). The fracture successfully healed without complications (h–k).