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## Original Article

## Staged treatment of pilon fractures

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## ABSTRACT

**Aim:** To evaluate outcomes following staged anterolateral plating of pilon fractures.**Methods:** Over a 5 year period, patients with pilon fractures received four treatment regimens (staged anterolateral plating, staged medial plating, definitive external fixation, early total care). We defined five outcomes (reduction, soft tissue complications, infection, non-union, malunion) and assessed the outcome of fractures treated by these interventions.**Results:** Staged anterolateral plating or staged medial plating achieved comparable reduction and soft tissue complications. Staged medial plating had higher infection rates, malunion and non-union rates.**Conclusions:** Staged anterolateral plating is superior to staged medial plating in the management of pilon fractures.

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## 1. Introduction

The distal 8–10 cm of the tibia, including the articular surface, is called the tibial pilon. Pilon fractures usually occur in adults in their thirties or forties caused by a fall from height or a motor vehicle crash.<sup>1</sup> Pilon injury is relatively rare and constitutes approximately 5–7% of all tibial fractures.<sup>1</sup> However, over 30% of pilon fractures are a result of high-energy trauma. These fractures are often associated with severe soft tissue trauma and concomitant polytrauma, making treatment extremely difficult and management challenging for the treating surgeon. Post-operative complications such as wound break down and infection are common and post-traumatic arthritis also occurs in a large number of patients even with adequate joint restoration.<sup>2</sup> Treatment of pilon fractures

involves a delicate balance between obtaining a strong and stable construct with anatomic articular reduction, while giving careful attention to the delicate soft-tissue envelope. The two-stage procedure protocol viz. the use of the external fixator in the first stage and the internal fixator in the second stage has been applied to successfully treat pilon fractures for many years in different countries around the world.<sup>2</sup> In general, fixation of the articular surface and tibial shaft is addressed through a variety of anterior incisions (anteromedial, anterior, or anterolateral) or posterior incisions. The classical approach is to use an anteromedial incision to fix the tibial plafond and a postero-lateral approach to fix fibular fractures and to address the posterior fragments. This type of approach mainly depends on the fracture pattern and surgeon preference. Recently, the anterolateral approach to the tibia

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has been popularized. Herscovici et al described this approach, called the Bohler incision and recommended this distal extensile approach for the management of foot and ankle injuries involving the anterior talar dome, talar neck, talonavicular joint, subtalar joint, calcaneo-cuboid joint, and the bases of the third and fourth metatarsals.<sup>3</sup> This approach provides excellent visualization of the anterior end of the distal tibia, the distal tibio-fibular joint and the ankle joint helping the surgeon achieve excellent reduction of the articular surface. More importantly, the approach provides better soft tissue envelope to cover the fracture site and the hardware used for the fixation. The drawback of the approach is however limited access to the medial ankle joint making fixation of the fractures of the medial malleoli difficult.

Logical thinking dictates that combining these two methods (staging and using the anterolateral approach) should give us the best outcomes in the management of these difficult fractures. We hypothesized that staged anterolateral plating is superior to all other modes of fixation including medial plating.

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## 2. Methods

We retrospectively collected data from patients who underwent treatment for pilon fractures between September 1, 2007 and September 20, 2012. Institutional review board approval was obtained prior to the start of the study. All patients aged 15–90 years who had been treated with staged anterolateral plating, staged medial plating, early total care, or definitive external fixation were considered for the study. Patients with other means of fixation (such as extreme nailing), with inadequate x-rays, with inadequate follow up of less than 9 months, as well as patients with isolated medial malleolar fractures, were excluded in the study. Out of 217 patients screened, 89 fractures met study inclusion criteria. Fifty seven (57) percent of patients screened were male and 43% were female. The majority (47%) of the patients were in the 40–59 age group followed by 37% of patients in the <40 age group. Thirty one (31) percent of the fractures were documented as open and 69% were closed. Fractures were classified according to the OTA guidelines as Type A (extra articular), type B (partial articular) or type C (intraarticular). Eleven percent (10 of 89) were type A fractures, 24% were type B (21 of 89) and 65% were type C (58 of 89). Fifteen fractures (16.8%) underwent anterolateral (AL) plating, 18 (20.2%) underwent medial plating, 24 (27%) underwent early total care and 32 (36%) had definitive external fixation (Fig. 1). Among patients who received staged treatment, the average time between the first and the second procedure was 12.7 days (range, 1–56 days). The distribution of open and closed fractures among the 4 treatment groups can be seen in Fig. 2.

### 2.1. Initial management

All patients who were identified with pilon fractures were seen in the ER with a senior consultant and a plan was formulated. Initial splinting was done until we were able to move the patient to the operating room. All patients with open fractures were moved to the operating room as soon as

possible. The wounds were copiously irrigated with 6–9 L of saline. Temporizing external fixators were used. Patients were taken back to the OR in 48–72 h for a repeat irrigation and debridement.

For patients with closed fractures, decision on definitive management depended on the soft tissue condition. Minimally displaced fractures with minimal swelling were treated with definitive fixation during the first OR visit. The rest were staged. Staging typically means temporizing the fractures with a spanning external fixator and coming back to the OR when the soft tissue conditions were more favorable.

### 2.2. Anterolateral plating

A tourniquet was used in all cases. A longitudinal incision was made from the base of the 4th metatarsal to a point 5 cm superior to the ankle joint. The incision was deepened to the deep fascia. In the distal aspect of the incision subcutaneous dissection was done more carefully to identify and protect the superficial peroneal nerve. All extensor tendons and part of the muscle bellies were swept medially to expose the tibial pilon. Access to Tillaux–Chaupt fragment and anterior distal tibio-fibular joint was immediate and the fragments were reduced under direct vision. Posterior and postero-lateral fragments were fixed with indirect means such as axial traction, making strategic small incisions to manipulate fragments. Final fixation was done with a Synthes anterolateral tibial plate. The proximal aspect of the plate was placed sub muscularly and fixed with screws placed through a separate incision.

### 2.3. Outcomes measured

We divided outcomes into five categories based on clinical and radiological observations (Table 1). The reduction was classified as satisfactory, based on the immediate post-operative x-ray. A reduction with an articular step off of less than 2 mm and angulation of less than 5° in both sagittal and coronal plane was classified as satisfactory. The second outcome we observed was immediate soft tissue complications; wound necrosis, wound dehiscence and blisters fit into this category. The third outcome was the presence of infection. All superficial and deep infections that required the institution of antibiotics, oral or intravenous (IV), were included. Hospitalization was not necessary to be included in this group. The fourth outcome was non-union. A fracture was classified as non-union when 9 months had passed from the day of the surgery and no evidence of radiological progression has been documented. The fifth and final outcome was a malunion. It was classified as malunion if the ankle healed with more than 5 degrees of angulation in either coronal or sagittal plane with respect to the mechanical axis of the extremity.

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## 3. Results

Both anterolateral plating technique and medial plating achieved comparable satisfactory reduction (Table 1). Satisfactory reduction was best achieved in the early total care cohort and

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