

# Percutaneous Contoured Locking Plate Fixation of the Pilon Fracture: Surgical Technique

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Preservation of the soft tissue is of particular importance in the care of pilon fractures. Improper soft tissue management has been attributed to high rates of nonunion, nerve injury, and failures (1–12). Traditional open reduction internal fixation (ORIF) of pilon fractures allows for direct visualization of the fracture(s) but is criticized for the large exposure and periosteal stripping. As a result, this approach has been blamed for high nonunion rates as well as failure of the soft tissue to accommodate implants (1, 5, 8, 13). External fixation has also been used but has not demonstrated much advantage to internal fixation and requires significant postoperative care. Also, external fixation has a higher incidence of malunion (6, 14) and has inherent risks for pin-tract infections (14, 15). In an attempt to limit the iatrogenic soft tissue injury (5, 6, 7), some surgeons have used a limited ORIF concentrating on restoration of the articular surface combined with ring or hybrid external fixation. The “2-stage” technique combines the benefits of both external and internal fixation, and is thought to limit soft tissue related complications by allowing soft tissue recovery time before the introduction of internal fixation.

Initial temporary external fixation combined with limited exposures for internal fixation (2-stage technique) at a later date allows for less disruption of the soft tissue envelope, leading to a decrease in complications associated with traditional open approaches. This may be achieved through relatively “small incisions” extending

from the pole of the malleolus to the metaphyseal fracture(s), although these incisions can still be quite long, especially when significant articular reconstruction and/or bone grafting is required. Other descriptions include “limited approach” or “minimally invasive”; and this differs from a true percutaneous approach.

With the advent of locking plate technology, surgeons have successfully managed a variety of fractures through smaller incisions to introduce the plate(s)—the percutaneous approach. Unlike traditional plating methods, locking plates do not rely on frictional forces between the plate/bone interface to achieve compression and stability. This allows for less damage to the periosteal blood supply, which may theoretically decrease the incidence of delayed or nonunion, soft tissue complications, and possibly secondary loss of fixation (16, 17). A recent study by Salton et al (18) demonstrated no major complications and only 4 minor soft tissue complications in a series of 19 patients treated with a limited incision and percutaneous medial plate fixation. More recently available contoured locking plates with multiple options for metaphyseal screw placement through the “percutaneous” incision allow for the surgeon to achieve stability through this access point. With percutaneous locking plates, the incision may be even smaller than used with the traditional 2-stage technique.

## Technique

Initial operative management may involve a single-stage approach (Figure 1) or the 2-stage approach, depending of fracture pattern and degree of edema (Figures 2 to 4). The percutaneous locking plate approach is probably best suited for closed noncomminuted metadiaphyseal pilon fractures with minimal articular surface involvement and when bone grafting of the metaphysis is not necessary (Figure 1, A, Figure 2, and Figure 5). Injury computed tomography (CT) is often obtained to determine the extent of articular damage and intra-articular fractures (Figure 1, B, and 2, B, Figure 6). If a 2-stage approach is used, a medially based external fixator is preferred (allows lateral access to a concomitant fibular fracture, if

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**FIGURE 1** A 24-year-old male with isolated left pilon fracture, treated in a single stage. (A) Injury x-rays demonstrate single articular fracture traversing the metaphysis. (B) Injury CT further reveals obliquely oriented fracture line, almost parallel with the anteromedial tibial surface, making this fracture pattern amenable to medial plate fixation. Fracture involves approximately 50% of the tibial plafond with some minor comminution of the distal lateral tibia. (C) Fluoroscopic series demonstrating locking plate application. After the plate is positioned, a nonlocking screw proximal to the fracture is placed to buttress the plate against the distally based fracture to reduce the fracture. It is important to fluoroscopically evaluate the reduction in multiple planes before introducing fixation distally into the plate. Anatomic reduction is achieved.

**FIGURE 2** A 56-year-old female with comminuted pilon and fibula fracture, treated with the 2-stage approach. (A) Injury radiographs. A large butterfly fragment of the tibial plafond is present. (B) Injury CT. The plafond is comminuted with the major fracture line in the coronal plane. Note comminution of lateral plafond.



present) to stabilize the fractures as well as maintain length (Figure 3, A, and Figure 5, B). In some cases, the articular plafond may be percutaneously fixated and reduced with a percutaneous screw across the major fracture line, although

definitive internal fixation should await soft tissue recovery (Figure 3, B). CT of the initial reduction allows the surgeon to assess the quality of the articular reduction before the second stage of percutaneously plating (Figure 3, C, and Figure 6).

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