Distal and tibial pilon fractures often are difficult to treat due to soft-tissue damage from high-energy trauma. Classical surgical treatment may produce additional trauma, eg, periosteal stripping and microcirculatory damage, which frequently induce infection, nonunion, or both.

This article presents minimally invasive plate osteosynthesis as a treatment method for these types of fractures. Minimally invasive plate osteosynthesis involves 1) respecting the soft tissue via small skin incisions, minimal surgical dissection, and gentle soft-tissue retraction; 2) indirect fracture reduction; and 3) minimal hardware application, eg, screw insertion with stab incisions and avoidance of excess screw placement. This technique results in minimal periosteal disturbance and faster callus formation, starting at 2 weeks postoperatively as opposed to 6 weeks.¹

**Materials and Methods**

**Patient Population**

When addressing pilon fractures, Ruedi and Allgower’s² principles of reduction are used: 1) restoration of fibula length; 2) articular surface reconstruction; 3) metaphyseal bone grafting, when necessary; and 4) medi-
Eighteen patients were treated using the minimally invasive plate osteosynthesis technique. Patient distribution according to AO classification was: 2 patients, type 43 C1; 6 patients, type 43 C2; 3 patients, type 43 C3; and 7 patients, type 42 A1 and 42 A2. The AO classification system is sometimes difficult to rely on, as noted by Swiontkowski et al.3

Patient age ranged from 42-61 years. Follow-up was from 1-4.5 years. No open fractures were treated. Ninety-five percent of fractures were treated on average after 3 to 9 days (due to secondary skin complications). In 3 patients, a temporary external fixator was used. Healing time ranged from 8-16 weeks. Weight bearing was allowed at different times according to the fracture pattern and presence of bone graft. In 41 A1 and 41 A2 fractures, partial weight bearing was allowed at 2 weeks.

**Surgical Technique**

When skin conditions are unfavorable (e.g., fracture blisters, necrosis, etc), open reduction is delayed, the leg is elevated, and transskelatal traction or an external fixator is applied. If a multifragmentary fracture pattern is present, a tibiotarsal external fixator (Orthofix, Verona, Italy) is applied to produce ligamentotaxis (Figure 1).

When skin conditions are favorable, surgery is performed immediately. The patient is positioned supine with the limb elevated for easier anteroposterior (AP) and lateral fluoroscopic imaging. Fibula length is restored first, with osteosynthesis plate fixation when necessary. Reconstruction of the distal tibia is addressed. A 4- to 5-cm oblique incision, from proximal-lateral to distal-medial, on the anteromedial surface of the distal leg is performed. The bony segment is distracted, and a plate is inserted from distal to proximal after creating a “tunnel” under subcutaneous tissue with a periosteal elevator. The plate is temporarily fixated with Kirschner wires (Figure 2).

Fracture reduction and alignment are checked fluoroscopically in the lateral and AP views. Once adequate reduction is achieved, proximal plate fixation with a percutaneous K-wire is performed. Screw fixation of the distal plate is performed. Lateral and AP plate alignment are checked again, fol-

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**RESULTS**

No infection or pseudoarthrosis was reported. One patient had radiographic malalignment (8° on AP view). In two patients (C2 and C3 fracture, respectively), <15° of limited range of motion was observed. On radiographs, complete healing time was observed within 16 weeks in C1, C2, and C3 fractures, and within 14 weeks in 41 A1 and A2 fractures. Average consolidation time was 105 days (range: 90-120 days).
Minimally invasive plate osteosynthesis is not easy and requires a learning curve. Adequate preoperative planning is mandatory, as well as accurate surgical timing in secondary skin compromise. Correct diagnosis using computed tomography is necessary to determine adequate fracture line visualization, articular surface depression requiring graft, and fragment position, to adequately plan the directions of the screws. Minimally invasive plate osteosynthesis is useful in 41 A1, 41 A2, and 41 C fractures (Figure 3). Healing time is accelerated, and complication rates are low.

Diagnosis and fragment identification are the first steps in planning surgery with the correct plating device. Once familiar with the minimally invasive technique, surgery is easier, radiographic exposure is low, and the results are encouraging.

REFERENCES