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Minimally-invasive plate osteosynthesis in distal tibial fractures: Results and complications

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ABSTRACT

Introduction: Distal tibial or pilon fractures are usually the result of combined compressive and shear forces, and may result in instability of the metaphysis, with or without articular depression, and injury to the soft tissue. The complexity of injury, lack of muscle cover and poor vascularity make these fractures difficult to treat. Surgical treatment of distal tibial fractures includes several options: external fixation, IM nailing, ORIF and minimally-invasive plate osteosynthesis (MIPO). Management of distal tibial fractures with MIPO enables preservation of soft tissue and remaining blood supply. This is a report of a series of prospectively studied closed distal tibial and pilon fractures treated with MIPO.

Materials and methods: A total of 21 patients with closed distal tibial or pilon fractures were enrolled in the study between March 2008 and November 2013 and completed follow-up. Demographic characteristics, mechanism of injury, time required for union, ankle range of motion and complications were recorded. Fractures were classified according to the AO/OTA classification. Nineteen patients were initially managed with an ankle-spanning external fixator. When the status of the soft tissue had improved and swelling had subsided enough, a definitive internal fixation with MIPO was performed. Patients were invited for follow-up examinations at 3 and 6 weeks and then at intervals of 6 to 8 weeks until 12 months.

Results: Mean age of the patients was 40.1 years (range 19-67 years). Eighteen cases were the result of high-energy trauma and three were the result of low-energy trauma. According to the AO/OTA classification there were extraarticular and intraarticular fractures, but only simple articular patterns without depression or comminution. The average time for fracture union was 19.7 weeks (range 12–38 weeks). Mean range of motion was 10° of dorsiflexion (range 5–15°) and 28.3° of plantar flexion (range 20–35°). Three cases were metalwork-related complications. Two patients underwent plate removal at 24 weeks because of plate impingement. There was one case of wound breakdown at 11 weeks. One patient had fracture union with tibial recurvatum of approximately 10°, without functional impairment. Two patients had delayed union.

Conclusion: MIPO is a reliable method of treatment for distal tibial fractures; it provides a high union rate and good functional outcome with minimal soft tissue complications. Skin impingement remains a common complication with MIPO, but this can be solved by timely plate removal.

Introduction

Distal tibial or pilon fractures are usually the result of combined compressive and shear forces, and may result in instability of the metaphysis, with or without articular depression, and injury to the soft tissue [1]. The complexity of injury, lack of muscle cover and poor vascularity make these fractures difficult to treat. Surgical treatment of distal tibial fractures includes several options: external fixation, IM nailing, ORIF and minimally-invasive plate osteosynthesis (MIPO); however, none of these methods are ideal. External fixation can be very useful as a temporary option for skeletal and soft tissue traction, but as a definitive treatment

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method may result in malunion, non-union, pin tract infection and ankle stiffness [2]. Intramedullary nailing has been proposed as a good option due to the biological concept of fixation and load shearing. Nevertheless, there are concerns about the routine use of IM nails for distal tibial fractures, including instability, malunion and non-union [3,4]. Precise reduction of articular fragments is achieved with ORIF and this method is traditionally used for surgical treatment; however, unfortunately it results in significant soft tissue stripping. Many authors report a high incidence of complications such as delayed union, non-union and infection [5,6]. The MIPO technique has recently been recognised as an alternative technique that enables indirect reduction and stable fixation with minimal biological footprint [7–9]. The aim of this prospective study was to evaluate clinical results and complications of MIPO in distal tibial fractures.

Materials and methods

A total of 24 patients with closed distal tibial or pilon fractures were enrolled in the study between March 2008 and November 2013. Demographic characteristics, mechanism of injury, time required for union, range of motion of ankle and complications were recorded. Fractures were classified according to the AO/OTA classification and were analysed preoperatively using radiographs and CT scans if there was articular involvement (Figs. 1 and 2). The union was considered to be complete if there was evidence of mature callus on radiographs in anteroposterior and lateral view, and absence of pain during weight-bearing. Nineteen patients were initially managed with an ankle-spanning external fixator (Fig. 3). If the distal fibula was fractured and the status of soft tissue at the lateral malleolus was good, ORIF was used primarily. When the status of the soft tissue had improved and the swelling subsided enough, a definitive internal fixation with MIPO was performed (Fig. 4). The involved leg was draped and a pneumatic tourniquet applied. A straight incision was made at the level of the medial malleolus with preservation of the saphenous vein and nerve. A subcutaneous plane was made with a long hemostat and chisel without causing additional periosteal damage. The fracture was reduced using manual traction with a Steinman pin applied through the calcaneus, percutaneously applied pointed reduction clamps (Fig. 5) and external fixator as a distraction tool when appropriate. Distal tibial locking plate was applied subcutaneously to fix the fracture. Reduction and position of the plate was checked with a C-arm (Fig. 6). Conventional screws were used to press the plate against the bone. In pilon fractures, articular block was reduced and fixed first with lag screws, then the plate was fixed with locking screws through separate stab incisions (Fig. 7). The incisions were irrigated and closed. The leg was immobilised in a splint with the ankle in the neutral position. All patients received three doses of cefazolin perioperatively. On the seventh day after surgery, patients started ankle exercises and they were encouraged and instructed to use the theraband. Patients were non-weight bearing for at least 6 weeks. They were invited for follow-up examinations at 3 and 6 weeks and then at intervals of 6 to 8 weeks until 12 months. Three patients who did not attend follow-up examinations were not included in the study.

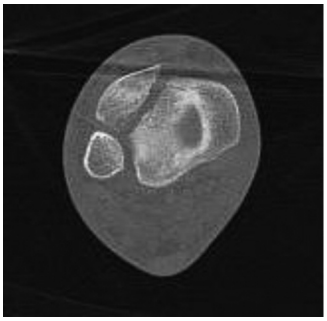

Fig. 1. CT scan of fractured articular surface of distal tibia.

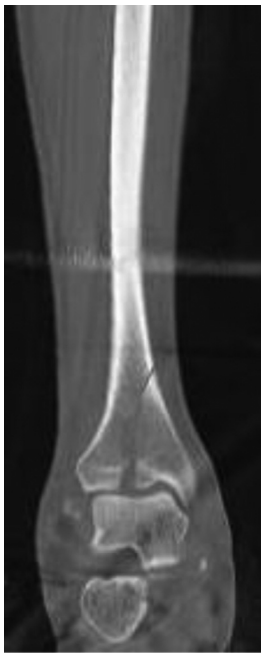

Fig. 2. CT scan of distal intraarticular tibial fracture.

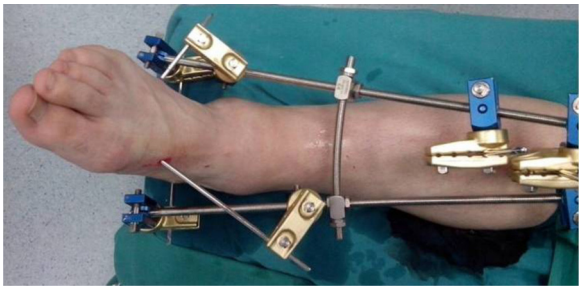

Fig. 3. Ankle-spanning external fixator.

Fig. 4. Skin wrinkling shows subsided oedema and recovered soft tissue.