



## Percutaneous plate fixation of fractures of the distal tibia

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**Minimally invasive plate osteosynthesis (MIPO) of the distal tibia offers several theoretical advantages compared to classic open reduction and internal fixation. A mechanically stable fracture-bridging osteosynthesis can be obtained without significant dissection and surgical trauma to the bone and surrounding soft tissues.**

In this retrospective study we looked at the results and complications in ten consecutive patients treated with percutaneous plating for fractures of the distal tibia and plafond with a minimum follow-up period of one year. No significant soft tissue problems occurred. The need for bone grafting should be carefully evaluated in every case as we encountered two delayed unions. All fractures healed within one year; there was no fracture malunion.

The use of indirect reduction techniques and small incisions to insert hardware is technically more demanding and requires strict radioscopic control throughout the procedure, but it considerably decreases surgical trauma to the soft tissues.

to the devitalisation of bony fragments and additional damage to the soft tissues.

In order to improve fracture healing, more "biological" methods have been developed over the last decades trying to lessen the surgical dissection, preserving the blood supply to the bony fragments and containing at least partially the fracture haematoma. As such, intramedullary fixation devices for example have become the gold standard for the treatment of diaphyseal fractures in the lower limb. Over the years however, open reduction and plate and screw fixation has remained the preferred treatment for peri-articular fractures.

More and more, new insights in reduction techniques and fracture healing are leading to the development of a "minimally invasive osteosynthesis" promoted by the AO group and others. The emphasis now lies on indirect reduction, axial alignment and stable fixation without disturbing the fracture environment and thus preserving most of the vascularisation and fracture haematoma, containing all necessary growth factors for bony

### INTRODUCTION

The surgical treatment of fractures has evolved a great deal since the development of the original "open reduction and internal fixation" technique by the AO group. To obtain maximal mechanical stability in order to achieve primary (endosteal) bone healing, exact anatomical reduction and strict rigid fixation were emphasized in the beginning. This however can rarely be obtained without significant dissection of the fracture and the surrounding soft tissues. Well-known complications like infection and delayed or non-union are frequently attributed

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healing.

Fractures of the distal tibia are a challenge for the orthopaedic surgeon as they are generally multifragmented and associated with severe soft tissue injury and swelling. Less invasive techniques such as percutaneous plating are very appealing when treating these types of fractures because a stable, fracture bridging osteosynthesis can be achieved without further damage to the soft tissues. They should allow for a better fracture healing with fewer complications and less need for additional operative procedures.

The purpose of this retrospective study was to evaluate the functional and radiographic results of ten consecutive patients treated in our department for fractures of the distal tibia where we felt a locked intramedullary nail could not be used as the fracture was too distal or had a distal intra-articular extension. In these patients we opted for an ORIF of the fibula and percutaneous plating of the tibia according to the technique described.

## PATIENTS AND METHODS

The medical charts of ten consecutive patients treated for fractures of the distal tibia (both intra- and extra-articular) with a technique of percutaneous plating were retrieved and reviewed. All patients were contacted and interviewed.

There were 6 men and 4 women, aged between 22 and 68 years (average 42,5 years).

Pre-operative radiographs were retrieved and all fractures were graded according to the AO classification. There were 2 type A fractures (extra-articular) and 8 type C fractures (complete intra-articular fracture, tibial pilon); there were no type B fractures. In the C-type group, there were two C.1 and six C.2 fractures. No type C.3 fractures were treated. Two of the six C.2 fractures were grade II open according to the Gustilo classification.

All closed fractures were treated with a single-staged procedure of open reduction and internal fixation of the distal fibula (if fractured) and a percutaneous plating of the distal tibia, with or without articular reconstruction and lag-screw fixation (depending upon the presence and degree of articular displacement). Both open fractures were first stabilised with plating of the distal fibula and an external fixator across the fracture and ankle joint, followed one week later by removal of the fixator

and application of a subcutaneous plate.

The patient was positioned supine on the operating table and a tourniquet was applied without exsanguinating the leg. If there was a fracture of the distal fibula (Weber B or C), this was treated first by a classic open reduction and internal plate and screw fixation through a lateral approach. Special attention was made to avoid any mal-rotation of the fragments. Consecutively, if necessary, a percutaneous reduction and 3.5 mm lag screw fixation of the articular fragments was carried out. Finally, after closed or percutaneous reduction of the distal tibia, a pre-bent reconstruction plate or large-fragment T-plate was inserted onto the anteromedial surface in a "retrograde" way (distal to proximal). This was performed through a small 5 cm medial incision by advancing the plate under the subcutaneous fat directly onto the periosteum. The periosteum itself was not opened. A small counter-incision was made proximally to optimally align the plate on the tibia (fig 1). The plate was then fixed with percutaneously placed screws. We made the small incisions for screw insertion according to the skin lines, which are horizontal and not longitudinal in the lower leg. This resulted in a good wound healing with only little scarring (fig 2). During the whole procedure radioscopic control was essential.

Post-operative treatment consisted of an AFO brace which was worn fulltime during two weeks. Intermittent non-weight bearing mobilisation was thereafter started. Partial weight bearing was allowed 4 to 6 weeks post-surgery, full weight bearing after radiological consolidation.

Figures 3 to 5 show radiographic examples of some fractures before and after treatment.

## RESULTS

The mean follow-up was 36 months (range : 12 to 58 months).

At the moment of our evaluation 5 patients could perform all sports they wanted; they did not have any pain or restrictions during daily activities. Two were unable to run, but were able to do some other sport activities and all activities at work and at home. Three said they could not participate in any sports, but did not have any restrictions in daily life. These were the patients with the shortest follow-up period.

On physical examination, we noted a good healing of all incisions. Only one patient was walking



**Fig. 1.** — a : Closed reduction of the fracture and temporary fixation with K wires ; b : A subcutaneous tunnel is made onto the periosteum of the anteromedial tibial surface. Distal skin incision for plate insertion.



**Figs. 2a & b.** — Clinical appearance of two treated legs one year postoperatively

with a slight limp. In two patients minor swelling of the ankle region was noted. All ankle joints were mobile within functional limits.

Some complications occurred during the treatment. One superficial wound infection on the lateral side was treated with antibiotics, without further problems. There was one case in which delayed union was noted and autologous cancellous bone grafts were added to the fracture site after 3 months, no hardware was removed or replaced. This fracture also healed without further complications. In one case the screws in the distal tibia broke and the hardware was replaced with a new plate and screws.

All radiographs one year after treatment demonstrated healing of the fracture(s). There were no malunions (varus or valgus of more than 5°), loss of reduction, articular incongruencies more than

2 mm or early signs of arthrosis.

All patients were happy with the cosmetic results because very little residual swelling was noted and the surgical wounds were rather small and healed without much scarring (fig 2).

## DISCUSSION

Minimally invasive plate osteosynthesis (MIPO) is the logical next step in the surgical treatment of fractures. It relies primarily on the indirect reduction of the fracture using various techniques, excellently described in the classic works of Mast and Ganz (8). In this way, the fracture environment is better preserved, as well as the blood supply to the bony fragments (4, 12). Theoretical advantages include less infection and wound problems and better fracture healing (7). No randomised prospective



**Figs. 3a & b.** — Distal tibial fracture extending into the ankle joint ; the articular fragments are fixated percutaneously with cancellous screws and one anteroposterior lag screw.



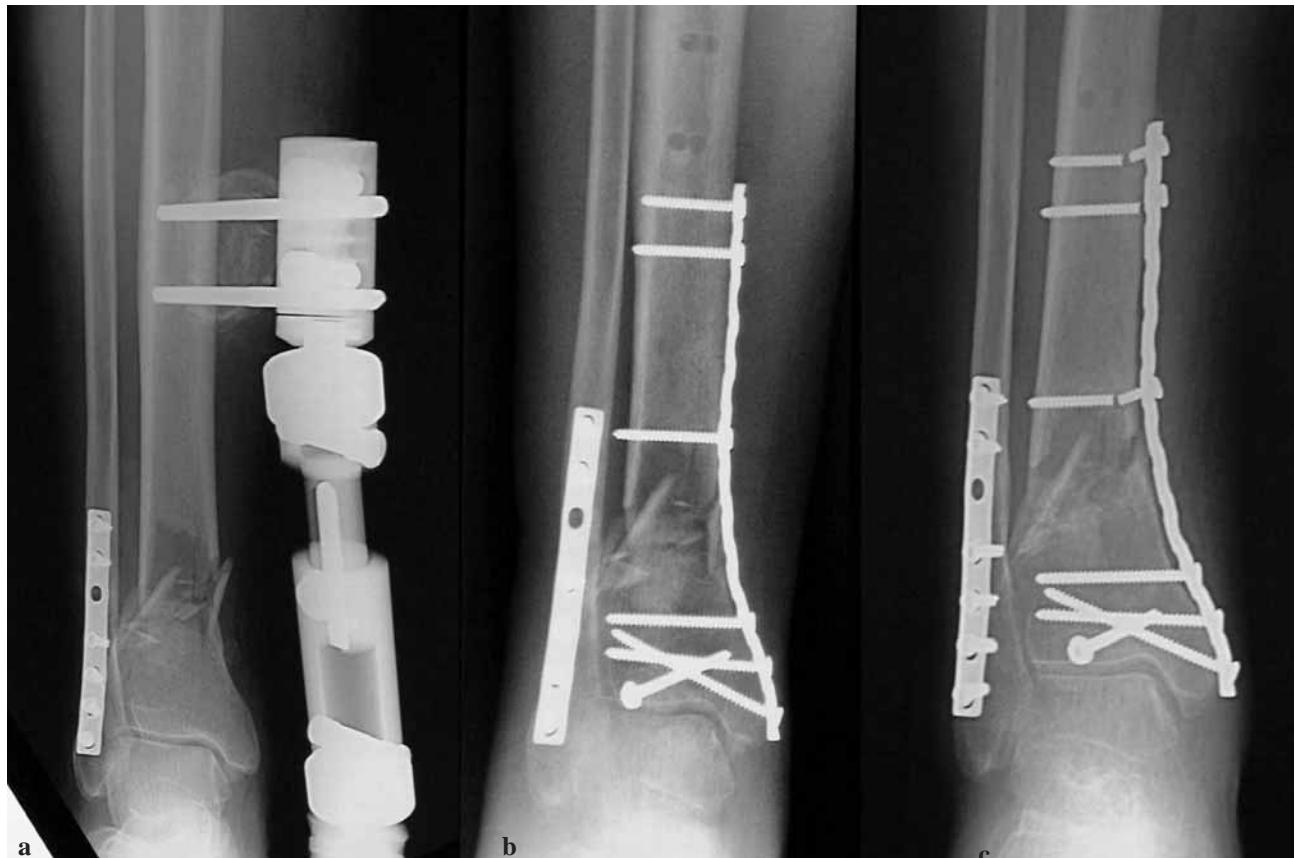
**Figs. 4a & b.** — Pilon fracture with metaphyseal comminution, treated with ORIF of the fibula and percutaneous plating of the distal tibia using a large fragment T plate.

studies have been published to date, but it is clear that MIPO results in less surgical trauma to the soft tissues (5).

Especially in the region of the distal tibia and ankle joint the soft tissues are frequently involved in the sustained trauma and play a central role in the choice of the surgical fracture treatment. Very

often, it is the initial condition of the surrounding soft tissues that limits the possibilities for osteosynthesis and directly relates to the outcome of distal tibial fractures (6, 9, 11).

The importance of a good, mechanically stable osteosynthesis in the treatment of fractures of the tibial plafond has been well emphasised. When



**Fig. 5a, b, c, d & e.** — Grade 2 open fracture of the distal tibia, treated with ORIF of the distal fibula and temporary external fixation of the tibia (a), followed by percutaneous plating of the distal tibia one week later (b). Three months later the hardware failed (c) and was replaced by a larger plate and the large metaphyseal defect was filled with autologous cancellous bone grafts. The fracture then successfully healed without further problems (d and e).

fixing the often comminuted metaphyseal fragment to the diaphysis in an attempt to restore proper axial alignment, very often considerable hardware and thus surgical dissection is required. Percutaneous plating of the distal tibia offers a similar stability as classic ORIF, however without the need for extensive dissection. Therefore fewer soft tissue complications can be expected, thus allowing the use of this technique even in the presence of moderate to severe soft tissue contusion or grade I

or II open fractures. As such, it promises to be a valid alternative to external (hybrid) fixation, although two-stage procedures may be performed (1, 5, 9).

We prefer single-stage osteosynthesis for closed fractures of the distal tibia. Open fractures are first stabilized by means of an ankle-spanning external fixator, followed by percutaneous plating of the tibia one week later.

The treatment of a fracture of the distal fibula is quite straightforward and well established in the literature (5). We believe it is very important to restore the original length and rotation of the lateral column of the ankle joint, although there is no general agreement in the literature (13).

Limited open or percutaneous reduction and lag-screw fixation of the distal tibial articular fragments is overall well accepted as the preferred treatment (5). This is not always possible in complex, very comminuted pilon fractures where a small anteromedial incision needs to be performed to access the ankle joint in order to reconstruct the articular surface of the distal tibia. This same incision can be used to insert the medial plate. It is safe as long as the lateral incision is posterior enough to have a good skin bridge between both incisions.

Although this technique of MIPO offers the possibility of achieving a good mechanical fixation of the distal tibia even in the presence of a metaphyseal defect (as it acts as an "internal fixator" (2)), the need for bone grafting should still be considered in every case (3, 6). This can either be done primarily or in a later, second operation when union is delayed.

Recently we have started to use locking-compression plates as they allow for the placement of locking head screws in the epiphysis and metaphyseal region, definitely contributing to the mechanical stability of the construct. Moreover these plates do not have to be perfectly contoured to the bone to achieve optimum stability, which makes their use more simple. However, these last cases were not included in this study because of too short a follow-up period.

Our study was performed retrospectively, but includes all patients treated in our department for a tibial plafond fracture or very distal tibial fracture

that was too low for an intramedullary nail. No patients were excluded and all were available for follow-up at least one year post-operatively.

Earlier published studies remain rather small like our presented series and no true randomised prospective studies have been presented comparing MIPO with classic ORIF and/or the various methods of external fixation.

## CONCLUSION

The final outcome of pilon fractures is largely dependent upon the residual articular displacement and chondral damage. It is obvious that these are not directly influenced by this technique of MIPO. Instead we believe the real advantages lie in the prevention of soft tissue problems and the possibilities for earlier and even single-stage operative procedures, contributing to a favourable outcome. Our presented study supports the few other published studies concerning percutaneous plating of the tibia and these should inspire more trauma surgeons treating distal tibia fractures to use minimally invasive techniques, in an effort to decrease morbidity and associated complications, especially of the soft tissues.

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