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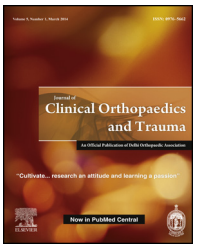

Original Article

Management of fractures of the distal third tibia by minimally invasive plate osteosynthesis – A prospective series of 50 patients

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ABSTRACT

Background: Minimally invasive plate osteosynthesis (MIPO) is an established technique for fixation of fractures of the distal third tibia. Our study aimed to manage intra articular and extraarticular fractures of the distal third tibia by the minimally invasive plate osteosynthesis technique and follow them prospectively. Clinical and radiological outcomes were studied and clinical indications & efficacy of the procedure reviewed. Though many studies on the subject have been done previously, these have been retrospective reviews or small series.

Methods: From May 2010 to May 2013, 50 patients of closed distal tibial fractures were operated by MIPO technique with a distal tibial anatomical locking plate having 4.5/5 proximal and 3.5/4 distal screw holes. The follow up duration was for 3 years.

Results: The mean fracture healing time was 21.4 weeks (range 16–32 weeks) and average AOFAS score 95.06 was out of a total possible 100 points. At last follow up, superficial infection occurred in 5 patients (10%); deep infection, implant failure and malunion in 1-patient each (2%).

Conclusion: MIPO technique provides good, though slightly delayed bone healing and decreases incidence of nonunion and need for bone grafting. This technique should be used in distal tibia fractures where locked nailing cannot be done like fractures with small distal metaphyseal fragments, vertical splits, markedly comminuted fractures and in fractures with intra-articular extension.

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1. Introduction

Fractures of the distal third tibia are unique in that the bone is subcutaneous with depleted muscular cover; the consequent decreased vascularity leads to complications like delayed bone union, wound complications such as dehiscence and infection. These fractures can be managed with various techniques. Small wire fixators,[1–3] and Open reduction and plating,[4,5] have been used with varying results.

In current orthopaedic practice, minimally invasive plating osteosynthesis (MIPO) and interlocking nailing are the preferred techniques for fractures of the distal third tibia. The intramedullary nail spares the extraosseous blood supply, allows load sharing, and avoids extensive soft tissue dissection.[6,7] However, proximal and distal shaft fractures can be difficult to control with an intramedullary device, increasing the frequency of malalignment.[8] Concerns regarding difficulties with reduction/loss of reduction, inappropriate fixation in fractures with articular extension, anterior knee pain[9] and hardware failure have slowed the acceptance of intramedullary nailing as a treatment of fractures of the distal tibia. The recent innovation of nails with tip locking is a testimony that earlier nails were insufficient fixation tools for distal tibia; however tip locking is technically difficult and fractures that require it are essentially difficult to fix with nails.[6,8,10]

Minimally invasive submuscular and subcutaneous plate fixation (MIPO) can address several of the issues associated with intramedullary nailing, while amalgamating all biological benefits of closed reduction and fixation.[11,12] We reviewed the clinical indications and efficacy of MIPO in distal third tibia.

2. Patients and methods

From May 2010 to May 2013, we conducted a prospective case series at our Level 1 trauma centre. A total of 50 patients with a mean age of 36 years were included. The study was approved by our institutional ethics committee and written informed consent was obtained from all patients. All closed fractures and Gustilo and Anderson Grade I compound fractures of the distal third tibia, with or without intra articular extension, upto 2 weeks old were included in the study. Informed consent for both the surgery and inclusion in the study were taken before the procedure. We excluded patients with pathological fractures, fractures older than 2 weeks, Gustilo and Anderson Type II and Type III fractures, and patients who were unfit for surgery.

After stabilising the traumatised patient, routine preanaesthetic investigations were carried out. Standard anteroposterior and lateral radiographs of the affected leg with knee and ankle joint were taken. The leg was immobilised in a plaster slab till definitive surgery. Patients with precarious skin condition were managed with limb elevation, regular dressing care and prophylactic intravenous antibiotics; surgery was delayed till appearance of the 'wrinkle sign', but performed within 2 weeks from trauma.

X-rays taken were evaluated for fracture morphology, level and extent of comminution. The fibular fracture was noted and surgical plan decided accordingly. The type and likely length of the plate was calculated.

1. Plate Screw Density (SD) ratio – We preferred an SD ratio of 0.5 in the proximal fragment and inserted a minimum of three screws in each fragment.[13] Thus preoperatively we planned for a plate which had 6 holes proximal to the fracture line. Due to the small distal metaphyseal fragment, this plate-screw ratio of 0.5 had to be compromised in the distal fragment, although we followed the principle where we could.
2. Comminution – In comminuted fractures, the plate span ratio was kept to 3 and in case of fractures with a simple fracture configuration, a plate 8–10 times longer than the fracture was planned for.[13,14]
3. LCP design – The choice of design of the plate was decided by the fracture anatomy in each individual patient. We used the distal tibial anatomical locked plate in distal fourth fractures with a small metaphyseal fragment since the metaphyseal flare of the plate allowed placement of the three minimum requisite screws (Fig 1A). In more proximal fractures where the distal fragment was large enough, we used the medial tibial locked plate which did not have a metaphyseal flare and thus had a lower plate profile (Fig. 1B).

Surgery was performed in our tertiary care trauma centre under regional anaesthesia with a tourniquet in the supine position on a radiolucent table. In the distal tibia, the locking compression plate was applied on the antero-medial surface. A locking compression plate of adequate length so that 6–8 cortices are obtained on either side of the fracture was kept on the leg and visualised under C-arm.

The fracture was reduced by indirect means without opening the fractured area.

i. Gentle manual traction/traction with calcaneal Denham pin and external manipulation e.g. a bolster under the ankle to correct the posterior displacement and angulation were adequate to reduce AO43A1 fractures.
ii. Use of percutaneous pointed reduction forceps and fixation of preliminary reduction by K-wires was needed in some cases (Fig 2A).
iii. Schanz pins inserted into the fracture fragments can be used to externally manipulate the fracture under radiographic control to achieve reduction.
iv. For type 43-A1 fractures a percutaneous lag screw from lateral to medial side was inserted under radiographic control so as not to jeopardise plate application on the medial side. A percutaneous pointed reduction forceps was used to make this feasible (Fig 2B).
v. In severely comminuted fractures, a femoral distractor was used.

The reduction was assessed repeatedly using visual and fluoroscopic control. Angulation, length of tibia and fibula, rotation and integrity of the ankle mortise were considered. The mechanical axis and anatomical axis of the lower limb was checked with the cautery cord. If the associated fracture fibula required fixation, it, was fixed by rush nail or one third