National Journal of Clinical Orthopaedics

ISSN (P): 2521-3466
ISSN (E): 2521-3474

www.orthoresearchjournal.com
2018; 2(2): 01-03
Received: 01-02-2018
Accepted: 02-03-2018

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Minimally invasive plate osteosynthesis of peri-articular fractures of distal tibia: A clinical study

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Abstract
Objectives: Treatment of distal tibial fractures using minimally invasive plate osteosynthesis (MIPO) technique may minimise damage to soft tissues and the vascular integrity of bony fragments. This is a study to assess the outcome of patients treated with MIPO technique for distal tibial fractures.
Methods: A Prospective study of 30 patients treated for distal tibial fractures using a distal tibial locking plate through the MIPO technique. Clcal and functional outcome was evaluated using Ankle score.
Results: There were 24 males and 6 females of mean age 40 years. The mean follow-up period was 14 months. According to the AO classification system, there were 12 patients with 43A type fractures, 10 patients with 43B, and 8 patients with 43C type fractures. Mean time to union was 18 months. There were 5 cases with superficial infections treated successfully using oral antibiotics and no failures of fixation. There were no cases of non-union/delayed union or rotational malalignment.
Conclusion: MIPO is an effective method of treatment for distal tibial fractures. The use of indirect reduction techniques and small incisions is technically demanding but decreases surgical trauma to soft tissues.

Keywords: Minimally invasive plate osteosynthesis, peri-articular fracture, distal tibia

Introduction
The Fractures of tibia are one of the most common fractures encountered in Orthopaedics of which, 7%-34% occur in the distal tibial region [1]. The poor soft tissue envelope, decreased vascularity of the region and accompanying soft tissue injury challenged orthopaedic surgeons with problems of infection, delayed union, non-union, and wound dehiscence [2, 3].
Management of distal tibial metaphyseal fractures is still a great challenge. Considering its anatomy, it is difficult to achieve and maintain reduction in these fractures. Reduction is even more difficult when a fibular fracture is found at the same level as the tibia. This fracture pattern reflects a high-energy mechanism of trauma causing an increased angular and rotational instability, limb shortening and soft tissue injuries.
Intramedullary nailing is generally not considered suitable for peri-articular tibial fractures. Intramedullary nails on metaphyseal fractures are technically hard to perform and must be addressed with care. Failures in controlling distal fragments may lead to deformities and mal union.
Conventional open reduction and internal fixation of such injuries results in extensive soft tissue dissection and periosteal injury, compromising the blood supply, and may be associated with high rates of infection, delayed union, and non-union. Similarly, external fixation of metaphyseal tibial fractures may also be associated with a high incidence of pin site infection and loosening in up to 50% of cases and malunion rates of up to 45%.
Minimally invasive plate osteosynthesis (MIPO) offers biological advantages. Reduced soft tissue dissection and exposition results in low surgical trauma and thus preservation of the blood supply is one of the main advantages of MIPO. Biological fixation is achieved with preservation of osteogenic fracture hematoma. We conducted this study to document the functional outcome of MIPO in distal tibial fractures.

Materials & methods
This study was conducted in medical college hospital for the duration of 2 years. Thirty patients, aged more than 18 years with metaphyseal and peri-articular fractures of distal tibia were included. Pathological fractures, compound fractures and neglected fractures were

excluded. After clinical and radiological evaluation, all the fractures were fixed with a precontoured distal tibial anatomical plate by MIPO technique. (Fig. 1a & 1b). Partial weight bearing allowed after 1 week depending on the fracture pattern. All were followed up at 6 weekly intervals till facture union. Detailed analysis of function of the patients with distal tibia fractures was done on the basis of following Ankle evaluation scoring system [Merchant & Dietz].

Results

Thirty patients who had 30 fractures with predominant right side (19) involvement were available for evaluation. There were 24 men (80%) and 6 women, ranging in age from 19 to 65 years old, with an average age of 40.43 years. Fractures classified as AO type A1 (40%), A2 (33.3%) & A3 (8%). Mean operating time was 90 minutes (range 60-120 minutes). The duration of follow-up ranged from 9 to 22 months (average 14.1 months). There were 5 cases of superficial infection managed with aseptic dressing. Average time taken for union was 18 weeks (range 14-20 weeks). Functional outcome was evaluated by Merchant & Dietz ankle scoring system. In our study, 26.7% patient had Fair result, 56.7% patient had good results, and 16.7% patients had excellent results. Functional outcome according to age, sex, type of fracture, and ankle score are summarised in tables 1-4 respectively.

Discussion

Metaphyseal fractures of the tibia are often associated with significant soft tissue injury. The key point in management of this injury is to recognize the importance of the soft tissue component [37, 38]. Failing to appreciate the soft tissue condition will invariably complicate the injury with infection, wound dehiscence or non-union. Where the soft tissue injury is significant, bridging external fixation is advantageous for skeletal and soft tissue stabilisation [39]. The results of operative treatment are dependent on the severity of the initial injury and the quality and stability of the reduction. The mechanism of injury, the status of the soft tissues and the degree of comminution affect the long term clinical result [40]. However, the most important factor is to achieve stable fixation and to allow early range of motion without unnecessary osseous and soft tissue devascularisation [41]. Metaphyseal fractures of tibia pose a treatment dilemma to the orthopaedic surgeon, with little consensus on optimal management [42, 43]. However, the most important factor is to achieve stable fixation and to allow early range of motion without unnecessary osseous and soft tissue devascularisation [41]. Minimally invasive techniques are based on principles of limited exposure, indirect reduction methods and limited contact between bone and implant. As a result of these principles this technique, as seen in present study, avoided major soft tissue complications and shortened the length of the patient's stay in the hospital. The advantages are minimal soft tissue damage, does not compromise bone vascularisation and presents a low complication rate, especially when compared to open reduction and internal fixation [44].

In current series 30 cases of metaphyseal fractures of the distal tibia, were treated by indirect reduction and minimally invasive percutaneous plating over a period of two years. In several reported series as well as in our series, the distal metaphyseal fractures of tibia have given excellent results. In our series 25 (80%) fractures united within 18 weeks of injury, is comparable with the other series as well [21-27]. In the current series, there was no deep infection. There were 5 cases of superficial infection, compares favourably with other series reporting rate of 3.5% to 15.3%. In our series, None of the patients had malunion and these results are comparable with the results of similar studies where in the malunion rate is reported to be 2-5 % [31, 34-37].

In our series none of the patients had plate exposure. This is also comparable to other similar studies which have reported a 0 - 10 % incidence of plate exposure, most commonly at the distal insertion site [24]. The average range of ankle movement achieved was 48.8 degrees (69.7%). The range of motion was more than 80% in 11 (61.11%) patients and these results are comparable with other series of studie [36, 37].

In our series, no patient developed fat embolism, compartment syndrome, peroneal nerve palsy or reflex sympathetic dystrophy.

Conclusion

Treatment of metaphyseal fractures of distal tibia, with minimally invasive plate osteosynthesis is a feasible technique with good rates of union and less complications.

The present series shows that metaphyseal fractures of tibia without articular extension, managed well with minimally invasive plating. It involves minimal surgical trauma and negligible blood loss. It provides the advantages of early ambulation, lower rates of infection, delayed union, non-union, and malunion compared to other treatment modalities.

A significant advantage of MIPO is less surgical trauma at fracture site not disturbing the fracture haematoma, less chance of infection, restoration early joint motion, early fracture union and early weight bearing allowing early functional restoration.

In our series we found that minimally invasive plating of metaphyseal fractures of distal tibia showed excellent to good results in 73% of patients without complications.

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