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Original Article

Distal Tibial Fractures Managed with Locking Compression Plate using Minimally Invasive Plate Osteosynthesis Technique: A Case Study

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Abstract

Introduction: The fractures of distal tibia fixed with open reduction and internal fixation with plate osteosynthesis lead to skin necrosis and infection, eventually leading to malunion and implant failure. Minimally invasive methods are an alternative to these complications.

Aim: The aim of this study was to evaluate clinical, functional, and radiological outcomes after minimally invasive plate osteosynthesis using distal tibial locking compression plates (LCPs).

Materials and Methods: In this prospective study, unstable fractures of the distal tibia, Grade I and II compound distal tibia fractures, and fractures in which acceptable closed reduction can be achieved were included in the study.

Results: The results of our study are much in favor of minimally invasive plate osteosynthesis for distal tibia fractures. The post-operative pain was minimal, and ankle function was very good. Although we had marginal skin necrosis in four cases, none of the cases went for skin and soft-tissue procedures.

Conclusion: The minimally invasive plate osteosynthesis using LCP proves to be a safer technique in the management of distal tibial fractures without intra-articular comminution by providing good fracture healing, enabling rapid functional recovery, and avoiding major skin complications.

Key words: Distal tibia fractures, Locking compression plating, MIPPO technique

INTRODUCTION

Increased incidence of road traffic accidents claims most of the human mortality and morbidity in the current age. Hence, it forms the major epidemic of the modern world. Of these, fractures of distal tibia have been difficult to treat. In this era of increasing life expectancy, there is a rise of elderly population which increases the incidence of these fractures in osteoporotic bones, adding to the morbidity.[1-3] Due to the proximity of these fractures to the ankle, regaining full ankle movement may be difficult. Soft-tissue damage, comminution, and fracture extension into the ankle joint lead to unsatisfactory results in many cases regardless of the treatment modality. A better understanding of the injury patterns, availability of better implants, the concept of early surgical fixation, and early post-operative mobilization[4,5] of joint all have convincingly improved the functional outcome of the patient to a large extent. Main challenges encountered in the treatment of distal tibia fractures are:

- These are high energy fractures
- Associated with extremely damaged soft-tissue envelope
- Increased incidence of compound injuries

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- Increased skin complications following surgery
- Comminution of the metaphysic and articular surface makes anatomical reduction difficult.

The resulting incongruence of articular surface leads to early secondary osteoarthritis.[6] Open reduction and internal fixation (ORIF) with plate osteosynthesis lead to skin necrosis and infection in >40% of patients, eventually leading to malunion and implant failure.[7] Intramedullary devices give inadequate stability due to wide medullary cavity leading to implant failure and screw breakage.[8] For compound fractures, initial treatment with an external fixator for wound care followed by a definitive mode of internal fixation was advocated. This involves multiple procedures which increased economical and mental stress for the patients.[9]

Aim

The aim was to study the clinical, functional, and radiological outcomes after minimally invasive plate osteosynthesis using distal tibial locking compression plates (LCPs).

MATERIALS AND METHODS

This is a prospective study conducted in the Department of Orthopaedics, Tirunelveli Medical College Hospital. The Institutional Ethics Committee approval and informed consent from the patients were obtained.

Inclusion Criteria

Age >20 years with closed, unstable fractures of the distal tibia, Grade I and II compound distal tibia fractures, and fractures in which acceptable closed reduction can be achieved were included in the study.

Exclusion Criteria

Grade III open fractures, irreducible fracture deformity, compartment syndrome/poor local skin conditions, and AO type C3 fractures (articular comminution) were excluded from the study.

Procedure

General measures

All the patients were received in the casualty department and were resuscitated. After the general condition improved, X-rays anteroposterior and lateral views were taken. A detailed pre-operative workup was done. All the cases were taken for surgical procedure as soon as possible. Those cases which were compound were initially treated with an external fixator.

Post-operative protocol

Limb elevation is recommended for the first 2-5 post-operative days. Physiotherapy with active assisted exercises is started immediately after the operation. Immobilization is not necessary. Clinical and radiological follow-up is advised after 2, 6, and 12 weeks. Based on the fracture consolidation, weight-bearing can be progressively increased from 6 to 8 weeks with full weight-bearing usually after 3 months. Supervised rehabilitation with intermittent clinical and radiographic follow-up is advisable every 6-12 weeks until recovery reaches a plateau, typically 6-12 months after injury. Weight-bearing radiographs are preferable to assess articular cartilage thickness. Angular stable fixation may obscure signs of non-union for many months.

Implant removal

Implant removal may be necessary in cases of soft-tissue irritation by the implant (plate and screws). The best time for implant removal is after complete remodeling, usually at least 12 months after surgery. In our study, all the patients were followed up carefully looking for any complication every fortnightly till fracture healing; and thereafter, every month up to 6 months; and every 6 months up to 2 years.

RESULTS

The overall results of our study are much in favor of minimally invasive plate osteosynthesis for distal tibia fractures. Eighty percent of the patients were between 30 and 50 years. Both male and female were included, the majority being males. The right side was common, and no bilateral cases were studied. Forty-four percent of the fractures were compound injuries. Forty-four percent of patients had associated injuries.

The mean duration between injury and surgery was 1 week. The average time for bone union was 18 weeks. Average ankle dorsiflexion was 20°. The results were excellent in 54%, good in 29% and fair in 17% of patients. The post-operative pain was minimal, and the post-operative ankle function was very good. Although we had marginal skin necrosis in four cases, they healed with regular dressings, and none of the cases went for skin and soft-tissue procedures.

The age groups of patient chosen for the study varied from 21 years to 51 years with the mean age of 36.5 years. The incidence of fracture was observed maximum between 30 and 40 years of age (Figure 1).

Eight among the eighteen cases had associated injuries which include four cases of patellar fracture, two cases of head injury, a case of supracondylar femur fracture and a distal radius fracture (Figure 2).

In our study, of the eighteen cases, there were eight cases of compound fractures (Figure 3). There were 10 cases of

simple soft-tissue injuries forming 56% study population, 5 cases of Grade I compound fractures (28%), 3 cases of Grade II compound fractures (16%).

The time interval between the date of admission to fixation varied from 1 day to more than 2 weeks. Among these, six cases were operated within 1 day (34%), eight cases operated within less than a week (45%), and four cases operated after 2 weeks (21%). There was a mean delay of 1 week for surgery (Figure 4).

Patients were serially followed and evaluated both radiographically and clinically for signs of union. Eleven cases (66%) had signs of union within 16 weeks, four cases (23%) had signs of union within 16-24 weeks, and two cases (11%) had union of more than 2 months. The mean time for the bone union was 18 weeks (Figure 5).

Of the 18 patients included in the study, one patient died in the late post-operative period due to comorbid medical conditions. Other patients are evaluated and studied for the functional outcome (Table 1).

DISCUSSION

Ruedi and Allgower were the pioneers in ORIF of pilon fractures.[10] They changed the outlook of management of distal tibia fractures in the early twentieth century. They achieved 74% good functional results following ORIF for distal tibia fractures. However, it was later recognized that all their cases were results of low-velocity injuries.[11,12] They could not reproduce similar results following the principles of open reduction internal fixation in high-velocity injuries. Helfet *et al.*[13] introduced a two-stage minimally invasive plate osteosynthesis (MIPO) for distal tibia fractures. Stage 1 – fibular internal fixation and spanning external fixation of tibia, Stage 2 – limited ORIF for the distal tibia. 40% of their cases were intra-articular fractures, 60% were extra articular fractures. They had a 10% incidence of >5° valgus deformity and a 10% incidence of >10° recurvatum deformity. The average ankle dorsiflexion achieved was 14° and plantar flexion was 42°. Our study is a prospective study of 18 cases of distal tibial fractures treated with MIPO using specially designed distal tibial LCP. We did medial plating in all cases. The age group of our patients varied from 21 years to 51 years with the mean age of 36.5 years. 95% of our patients were males. Fifty percent of our cases were extra-articular and 50% intra-articular fractures. Forty-four percent of the fractures were compound in nature. Forty-four percent of our cases

Table 1: Distribution of complications in study patients

Complications	Patients
Normal bone union	15
delayed union	2
Shortening	2
Joint stiffness	2
Valgus angulation	2
Marginal skin necrosis	4
Deep infection	2

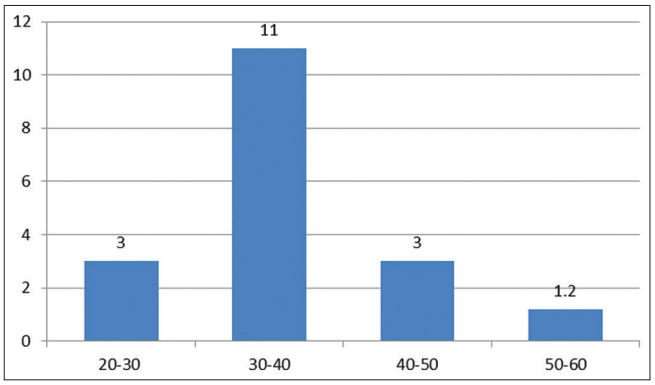

Figure 1: Age distribution of study patients

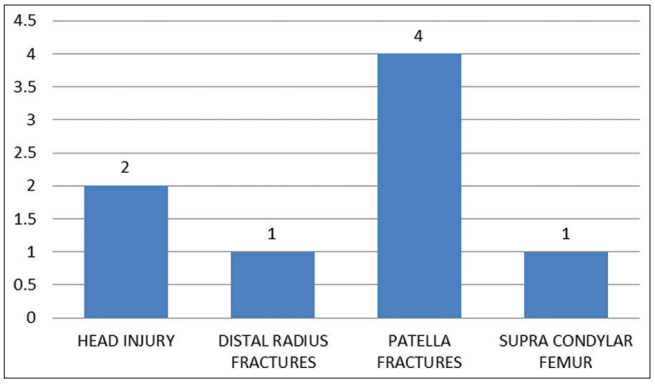

Figure 2: Associated injuries in study patients

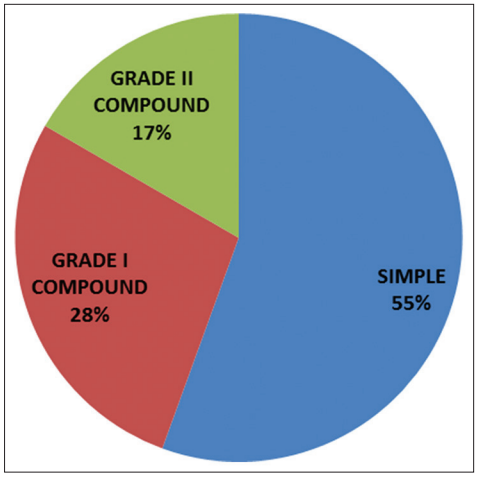

Figure 3: Fracture types in study patients

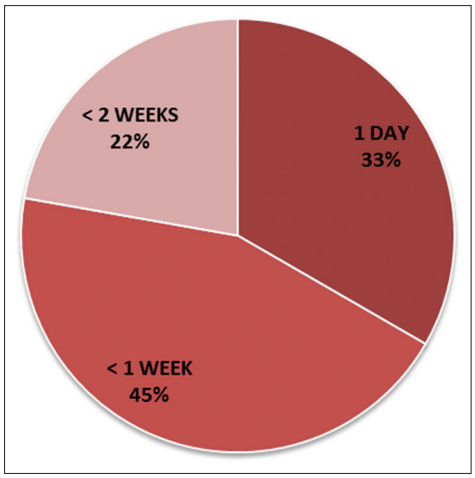

Figure 4: Delay in surgery

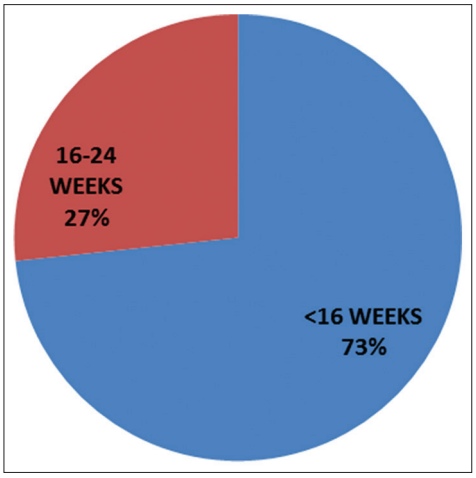

Figure 5: Time for union

had associated injuries. We did not perform preliminary external fixation as in the Helfet *et al.*'s[13] series. We selected patients with apparently good soft-tissue condition. Thus, a single-stage MIPO protocol was followed, thereby providing a shorter duration of treatment. This single-stage procedure reduced the surgical insult, thus preventing complications such as wound dehiscence, sepsis, delayed or non-union. The MIPO technique enables a bridging fixation without disturbing the comminuted segments and the surrounding soft tissue. We used an anatomically prebent plate unlike Helfet *et al.*,[13] thus achieving stronger fixation in the metaphyseal region as it permitted insertion of 2 or 3 cancellous 6.5 mm screws in the small distal segment. The mean duration between injury and surgery in our study was 1 week. The average time for the bone union was 18 weeks. We achieved 54% excellent, 29% good, and 17% fair results. The average ankle dorsiflexion was 20°. All our cases were followed for a mean period of 14.2 months averaging from 28 months to 4 months. Of the 18 cases, bony union was obtained in 17 cases (one patient died during follow-up). Two cases had delayed union. The prime reason for the delayed union in both the cases was intact fibula which made the fracture site to distract. There was no case of implant failure. The average time of bony union was 18 weeks compared to 18.5 weeks by Shrestha *et al.* and 21.2 weeks by Hasenboehler *et al.*[1,8] There were two cases that were complicated by ankle stiffness. Both the patients had poor compliance in the post-operative period which was the result of ankle stiffness. Shortening of <2 cm was seen in two patients, both of which had highly comminuted distal tibial fractures with diaphyseal extension. They were managed with heel raise. Although we had marginal skin necrosis in four cases, they healed with regular dressings, and none of the cases went for skin and soft-tissue procedures. Thus, with regard to functional outcome, our results are comparable to those of Shrestha *et al.*[1] These results were possible because of proper case selection, perfect articular reconstruction, and meticulous soft-tissue handling.

CONCLUSION

Thus, minimally invasive plate osteosynthesis using LCP proves to be a safer technique in the management of distal tibial fractures without intra-articular comminution by providing good fracture healing, enabling rapid functional recovery, and avoiding major skin complications.

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