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Original Article

Outcome Analysis of Distal Tibial Fractures Managed by Open Reduction Internal Fixation Using Plate Osteosynthesis

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Abstract

Introduction: Fracture of the distal tibia is one of the common fractures encountered by an orthopedic surgeon. Many studies have been associated even as little as 1 mm incongruence of articular surface landed with worst outcome. Distal tibial fractures are complicated by poor bone stock, soft tissue complication, and poor vascularity, leading to non-union, gross comminution, and malalignment.

Aim: The aim of the study was to evaluate the functional outcome analysis of distal tibial fractures managed by open reduction internal fixation using plate osteosynthesis.

Materials and Methods: This a prospective study conducted at KAPV Medical College, Tiruchirappalli. 20 patients treated with distal tibial plating. Fibular plating was done in eight of these patients. Patients were analyzed using Karlström and Olerud scoring system, with follow-up of 3–18 months.

Results: Ten patients had excellent functional results, six patients had good results, three patients had acceptable results, and one patient had a poor result. Quality and vascularity of bone seem to influence the outcome to a large extent.

Conclusion: Based on our study, we conclude that distal tibial fractures managed with plate minimally invasive percutaneous plate osteosynthesis technique allow early mobilization of the patients and provide a good functional outcome.

Key words: Distal tibial fracture, Minimally invasive procedure, Plate, Screws

INTRODUCTION

Distal tibia fractures include extra-articular and intra-articular fractures. Based on AO Muller classification system, type A – extra-articular fractures; type B - partially articular fractures; and type C - complete intra-articular fractures.[1] Incidence rates of distal tibial fractures vary considerably by age and gender, range from a low of 3/10,000 per year among 30–34-year-old women to a high of 28/10,000 per year among 15–9-year-old boys.[2] Mechanism of injury is mostly due to low-energy trauma, usually leads to simpler fracture patterns with minimal soft tissue injury, while high-energy trauma with axial compression (fall from height and road traffic accident) produces complex intra-articular fractures with metaphyseal impaction and bone loss. Direct fractures are usually transverse, oblique, or comminuted, while indirect ones are torsional and rotational fractures.[3,4] There are various treatment options for distal tibial fractures including non-operative, external fixation, and internal fixation. The indications differ based on the patient, demands, and type of fractures.[5] Open reduction and internal fixation (ORIF) with plate osteosynthesis leads to skin necrosis and infection in >40% eventually leading to implant failure and malunion. The intramedullary (IM) device gives inadequate stability due to wide medullary cavity, leading to implant failure and screws breakage.[6]

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Aim

The aim of the study was to evaluate the functional outcome analysis of distal tibial fractures managed by open reduction internal fixation using plate osteosynthesis.

MATERIALS AND METHODS

This prospective study was conducted in the Department of Orthopaedics and Traumatology, KAPV Government Medical College and Hospital between 2017 and 2018. 20 distal tibial fractures were operatively treated with plating at our institutions of which 15 males and 5 females. Age group of the patient was 20–60 years. The most common mode of injury was road traffic accidents. There were six compound fractures. Compound cases were surgically debrided on day 1 and wound management was done, and then, flap cover and plating done within 3 weeks.

INCLUSION CRITERIA

The following criteria were included in the study:

- Age >20 years with closed fracture, unstable fractures of the distal tibia.
- Grade I and Grade II compound distal tibial fractures.

Exclusion Criteria

The following criteria were excluded from the study:

- Grade III open fractures.
- Irreducible fracture deformity.
- Compartment syndrome.
- Poor local skin conditions.
- AO type C3 fractures (articular comminution was excluded from the study).

Surgical Technique

In the surgical technique, patient in supine position, universal approaches (anteromedial or anterolateral) for all type A, B, and C fractures. Under C-arm guidance, articular surface was visualized found maintained after fracture reduction, and then, the appropriate plate was chosen, and then, either anteromedial or anterolateral plating is done. Minimally invasive percutaneous plate osteosynthesis (MIPPO) technique with locking plate was used in 10 patients. Contoured narrow dynamic compression plate was used in 10 patients. The plate was placed as distally as possible. At least six cortex fixations in proximal and distal fragments were ensured.

Post-operative Protocol

Post-operative rehabilitation, a below knee plaster splints applied in a neutral position for 4 weeks. The lower limb is kept elevated with isometric knee and ankle exercises on day 1 after removal of the suction drains. After 5–7 days, ambulation is started with non-weight-bearing, allowing toe-touch partial weight-bearing after the 2nd week, and depending on the quality of fixation and reconstruction, as well as on patient compliance. Full weight-bearing started after 8–10 weeks depending on radiological fracture consolidation and clinical follow-up. Follow-up was done at immediate post-operative, 3 weeks, 6 weeks, and every 3rd month up to 15 months. Anteroposterior and lateral view X-rays taken. The radiological union was evaluated. Functional scoring of Karlström and Olerud was done.

RESULTS

According to Karlstrom and Olerud functional scoring system is done for all patients.

Overall, 10 patients had excellent functional results, six patients had good results, three patients had acceptable results, and 1 patient had poor result.

Evaluation of post-operative radiographs for adequacy of reduction revealed excellent results in 14 cases (70%). Good reduction was achieved in 4 cases (20%). Poor reduction occurred in 2 cases (10%) [Figure 1 and Table 1].

DISCUSSION

Non-surgical treatment of distal tibial fractures can increase the incidence of malalignment with unacceptable shortening.[7] The most common surgical methods for treating distal tibial fractures are IM nailing or plating. However, malalignment of the distal tibia is common after nailing. Plate osteosynthesis allows the articular reduction and varus/valgus realignment. Our study included 20 patients distal tibial fractures managed with plate osteosynthesis and their functional outcome evaluated. Minimally invasive percutaneous plating allows to reduce soft tissue problems and prevents devascularization of the fracture fragments. Anatomic reduction of the fracture site with minimally invasive plating is technically demanding. Fibular plating was done in patients with varus/valgus malalignment, fracture within 5 cm of syndesmosis, and all implant failure patients. Malunion is noted in one patient with acceptable varus/valgus deformity, patient deferred further treatment. Non-union in one patient managed with bone grafting at the 6th month. Bone grafting was done in six cases as secondary procedure for three implant loosening cases, two osteoporotic comminuted fractures, and one non-union case. Hence, 30% of cases required augmentation with bone grafting. Other difficulties faced were symptomatic problems regarding implant prominence which necessitated implant exit in three patients done 15 months after bony union. Wound-related problems

Figure 1: A 27-year-old male patient with a history of RTA with AO type 2 distal tibial fracture treated with open reduction and internal fixation with LCP using MIPPO technique for tibia and 1/3 tubular plate for fibula. (a) Pre-operative X-ray, (b) post-operative X-ray, (c) 6-month follow-up, (d) clinical photos

Table 1: Distribution of Outcome

Number of patients				
Criterion (symptoms)	**Excellent score**	**Good score**	**Acceptable score**	**Poor score**
Subjective ankle pain	10	7	3	-
Gait	11	6	2	1
Work and sports	10	6	3	1
Angular and rotational displacement	16	3	1	-
Shortening	18	1	1	-
ROM restraint ankle	-	10	8	2

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Table 2: Distribution of Complications

Complication	Number of patients (%)
Wound healing problems (infection, dehiscence)	2 (10)
Non-union	1 (5)
Malunion	1 (5)
Implant loosening	3 (15)
Secondary osteoarthritis	Nil

(10%) were noted in our study, all of them were treated non-operatively. Open methods of fixation carry a higher rate of infection and soft tissue problems. Old age, osteoporosis, and ankle ligament injuries associated with a delay in post-operative rehabilitation, joint mobilization, and weight-bearing. These patients were managed with calcium and Vitamin D supplementation to augment fracture union.

In a prospective randomized trial, Im and Tae concluded recently that ORIF could restore alignment better than IM nailing.[8] They treated 64 consecutive distal tibial fractures with ORIF or IM nailing. They found an average angulation of 0.9 after ORIF versus 2.8 after IM nailing (P = 0.01). Unfortunately, there is no description of the angulation measurements. Varus and valgus malalignment are usually determined by measuring the angle between the center of the knee down the middle of the proximal shaft and proximally from the center of the ankle up the middle of the distal shaft. The slightly S-shaped tibial shaft in many normal individuals means that the mechanical axis of the tibia rarely passes down the middle of the medullary canal; this makes the conventional method of measuring the angulation of malunion potentially unreliable. Vallier *et al.* showed that angular malalignment is more with nail, varus of >5° in 29% and 5.4% with plating.[9]

Distal tibia fractures are complex cases and need appropriate treatment to limit the incidence of complications. For acute fractures without skin injury, we prefer a stable and rigid internal fixation in a one-stage procedure. Limited internal fixation can be used for fractures without important comminution and easily reducible by traction or external manipulation. However, with this technique, a non-weight-bearing cast is recommended. ORIF with conventional or locking plates should be used for comminuted cases to reduce the articular surface perfectly. Surgical approaches

must preserve the soft tissue and can be anteromedial or anterolateral according to surgeon preference and fracture localization. One advantage of the locking plate is to permit faster full weight-bearing and stronger fracture stabilization as an internal fixator. Despite the advantages of closed reduction and slight disturbance of soft tissue, minimal invasive plate osteosynthesis (MIPO) has the disadvantages of non-accurate reduction. The fragments may be not tightly compressed which could increase the risks of delayed union and non-union, especially for simple fractures (i.e., type A3). Several studies have reported the rate of delayed union or non-union to be 5–17%.[10,6] Admittedly, malreduction is also inevitable in the MIPO group; however, careful management under an image intensifier and post-operative guidance should effectively prevent unacceptable deformity. Cadaver research suggests that the MIPO technique may carry a higher risk of injury for saphenous nerve and long saphenous vein.[11]

CONCLUSION

Distal tibial fractures stabilized with MIPPO technique had earlier fracture healing and good soft tissue healing comparative to patients operated with open surgical technique. MIPPO technique after good articular reduction gives superior results in good surgical hands. Fibular fracture stabilization offers stability to the MIPPO construct, prevents malalignment, and promotes bony union in osteoporotic fractures.

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