

Original article

**Management of Distal Tibial Fracture (AO Type 43-A) by MIPO with Precontoured Distal Tibial Locking Plate**

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**ABSTRACT**

**Background:** Tibial fractures are difficult to treat as many diverse treatment methods applicable for different fractures. Minimally Invasive Plate Osteosynthesis (MIPO) is an established technique for fixation of fractures of the distal tibia.

**Methods:** The study was conducted at the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh from January 2014 to December 2015. 10 patients of closed distal tibial fractures (AO Type 43-A) were operated by MIPO technique with a precontoured distal tibial locking plate. The follow up period was for 6 months. The outcome was measured according to Olerud and Molendar Grading system.

**Results:** We conducted our study among young adults mean age was 42yrs and male and female participants were equal (1:1). The mean fracture healing time was 14.8±2.32 weeks. 80% patients scored satisfactory functional outcome in this treatment method. Majority (80%) of the patients returned to routine pre-injury working activities. At follow up, superficial infection occurred in 1 patient (10%), only 20% patients exhibited valgus malalignment of less than 5 degree. No deep infection, implant failure and non-union were found.

**Conclusion:** MIPO is a stable fixation and provides micromotion at fracture site that leads to early callus formation which ultimately cause early secondary union. So, we recommend MIPO technique with precontoured distal tibial locking plate for distal tibial fracture (AO Type 43-A) management.

**Keywords:** Distal tibial fracture, Minimally Invasive Plate Osteosynthesis (MIPO), Precontoured Distal Tibial Locking Plate.

**INTRODUCTION**

Treatment of distal tibia fracture is challenging because of subcutaneous location with precarious blood supply. There are many operative options for such fractures such as closed reduction and Intramedullary Inter-Locking (IMIL) nailing. Open reduction and internal fixation (ORIF) with plating, closed reduction and per cutaneous plating or external fixators including Ilizarov external fixator. Each of these techniques has their

own merits and demerits. IMIL nailing has been reported with higher rate of malunion and risk of nail propagation into ankle joint.<sup>1</sup> Wound infection, skin breakdown and delayed union or nonunion are associated with conventional osteosynthesis with plates.<sup>2</sup> Similarly, external fixators and Ilizarov fixators may lead to pin tract infection with osteomyelitis, pin loosening, malunion which is cumbersome and uncomfortable for

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patient.<sup>3</sup> Non-operative treatment is one option which avoids the risks associated with surgery, but we cannot control the distal fragments, so malunion results.<sup>4</sup>

Minimally invasive plate osteosynthesis (MIPO) offers one of the best possible option as it permits adequate fixation in a biological manner provided that overlying skin condition must be healthy. The Locking Compression Plate (LCP) provides enhanced stability in these situations. It is possible to use these plates in a minimally invasive technique without fear of secondary displacement in the absence of perfect contouring.<sup>5</sup> It acts as an internal external fixator provides micromotion at fracture site leads to secondary union. The MIPO technique preserves most of the osseous vascularity and fracture hematoma and thus providing for a more biological repair.<sup>6</sup> Patients achieve union very soon compared to other methods of treatment. Early mobilization and early weight bearing after MIPO makes encouraging to both patients and surgeons.

We aimed to manage distal tibial fractures by the MIPO technique by reviewing clinical and radiological outcomes and efficacy of the procedure.

## **METHODS**

This prospective observational study was conducted at the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh from January 2014 to December 2015 to assess the functional outcome of management of distal tibial fracture (AO Type 43-A) by MIPO with precontoured distal tibial locking plate.

Ten adult patients of 18-60 years of age of both sexes were included in the study with closed distal tibial shaft (AO type 43A1-3). Fracture included with age less than three

weeks and soft tissue injury Tscherne grade 0 and grade 1.

Under spinal anesthesia and with antibiotic prophylaxis surgery was performed on a radiolucent table. The fracture was reduced under fluoroscopic visualization. A 3-4 cm vertical incision was given at the center of the medial malleolus and a subcutaneous tunnel was opened. The selected locking plate was tunneled proximally subcutaneously across the fracture site. The position of the plate was checked by C-arm and the locking screws were inserted when the fracture reduction was satisfactory. The incision was closed, and a well-padded plaster slab was applied. Post operatively the limb was elevated, and knee range of motion was started on the 2<sup>nd</sup> postoperative day. Cast was removed at 3-4 weeks. Partial weight bearing was started at 6-8 weeks and full weight bearing was allowed after fracture union.

Variables of interest were recorded in a structured data collection form. Data were processed and analyzed using SPSS. Functional outcome was observed according to Olerud and Molendar's ankle score criteria. Ethical clearance was taken from the ethical review board of the institute.

## **RESULTS**

A total of 10 patients of closed distal tibial fractures (AO Type 43-A) were included in the study to evaluate the outcome of fixation by MIPO technique with a precontoured distal tibial locking plate.

Most of our patients 5(50.0%) were age group 31-40 years. Mean SD age was 41.8±9.49 and ranging from 32– 51 years. (Shown in Fig. 1) Out of 10 cases, 5(50%) patients were male and 5(50%) patients were female. The male: female ratio is 1:1

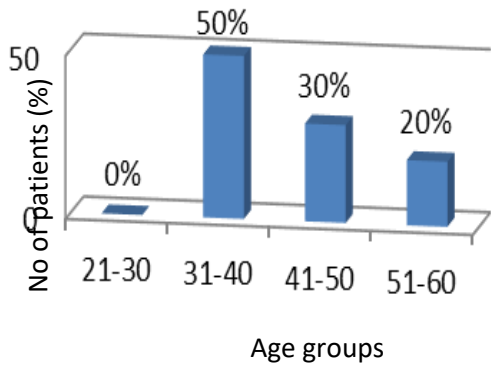


Fig. 1: Bar diagram showing the age distribution of the study patients (n=10)

Most common 8(80.0%) cause of injury was road traffic accident (RTA). Shown in Fig.2

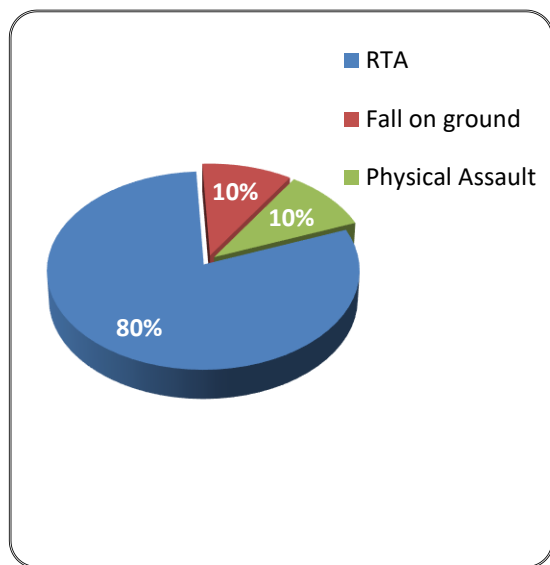


Fig. 2: Pie diagram showing the mechanism of injury of the study patients (n=10)

In our study of 10 distal tibial fractures, maximum 6(60%) patients were AO Muller’s Type A3, then 3(30%) patients were AO Muller’s Type A2 and another one patient (10%) was AO Muller’s Type A1. (Shown in tab. I). Only 1(10%) AO Muller’s A3 type fracture was associated with concomitant fibula fracture. Fracture side distribution was equal for both left and right.

Tab. I: Distribution of the study patients by type of fracture (n=10)

Type of fracture	Frequency	Percentage
AO Muller's A1	1	10.0
AO Muller's A2	3	30.0
AO Muller's A3	6	60.0
Total	10	100.0

Among the 10 distal tibial fractures, maximum 8(80%) patients had grade 0 soft tissue injury, and 2(20%) patients had grade 1 soft tissue injury. Shown in Tab. II

Tab. II: Distribution of the study patients by grade of soft tissue injury (n=10)

Tscherne’s Grade	Frequency	(%)
Grade 0	8	80.0
Grade 1	2	20.0
Total	10	100.0

**Follow-up of the of the study patients:** Fig. 3 shows the pain status of the study patients, 2(20.0%) patients complaint of intermittent pain during the postoperative follow-up period.

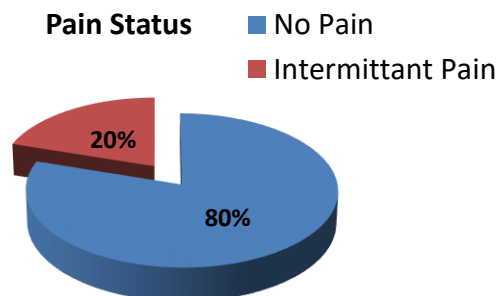


Fig 3: Pie diagram showing pain status

Most of the fractures 6(60%) were united between 12-14 weeks. Mean duration of radiological union was 14.8±2.32 weeks. There was no delayed or nonunion. Maximum 6(60%) patients full weight bear at

time 14-16 weeks (Shown in Tab. III). Mean full weight bearing time  $16.6 \pm 2.31$  weeks.

Tab. III: Radiological union and full weight bearing in patients in different follow-up periods

Follow-up (weeks)	Radiological union	achieved full weight bearing
12-14 wk	6	--
14-16 wk	2	6
16-18 wk	2	2
18-20 wk	--	2
Total	10	10

Tab. IV showing the range of motion, maximum 5(50%) patients had ankle dorsiflexion 10 degree. And 3(30%) patients had 5 degree of ankle dorsiflexion then 2(20%) patients had no dorsiflexion. Mean ankle dorsiflexion was  $6.5 \pm 4.11$  degree.

Tab. IV: Ankle Dorsiflexion (n=10)

Ankle dorsiflexion	Frequency	%
0 degree	2	20.0
5 degree	3	30.0
10 degree	5	50.0
Total	10	100.0

Out of 10 patients, 2(20%) patients had limb length shortening <0.5 cm and in 2(20%) patients had only 5-degree valgus mal-alignment. The remaining patients had no such issues. Shown in Tab. V

Tab. V: Other followup parameters (n=10)

Followup parameters	Frequency	%
Limb length discrepancy (0-0.5 cm)	2	20
Valgus mal-alignment ( $\leq 5$ degree)	2	20

1(10%) patient had ankle stiffness, 1(10%) patients had Superficial surgical site infection

and rest of the patients 8(80%) had no complications. shown in Tab. VI

Tab. VI: Complications (n=10)

Complications	Frequency	%
Surgical site infection	1	10
Ankle stiffness	1	10
No complications	8	80
Total	10	100

Tab. VII showing functional results assessed by Olerud and Mulendar criteria, 3(30%) patients had excellent outcome, 5(50%) patients had good outcome and 2(20%) patients had fair outcome.

Tab. VII: Functional result assessment by Olerud and Molendar Scoring (n=10)

Olerud and Molendar Grading	Freq.	%
Excellent (91-100)	3	30
Good (61-90)	5	50
Fair (31-60)	2	20
Total	10	100







Note: According to Olerud and Molendar Grading (1984), excellent and good outcome are considered as satisfactory & fair and poor outcome are considered as unsatisfactory. Satisfactory = Excellent + Good = 3 + 5 = 8 = 80% and Unsatisfactory = Fair + Poor = 2 + 0 = 2 = 20 %

**Final outcome:** Most of the patients 8(80%) were satisfactory and rest of them 2(20%) patients were unsatisfactory. Tab. VIII showing this.

Tab. VIII: Distribution of the results according to the final outcomes (n=10)

Results	FRQ	%
Satisfactory (Excellent & Good)	8	80%
Unsatisfactory (Fair & Poor)	2	20%
Total	10	100%

In this study, 60% to 100% satisfactory result found by 95% Confidence Interval.

Illustrations of Case No-1:	
	
Picture 1: Placement of locking plate by MIPO technique.	Picture 2: Fluoroscopic view of correct placement of locking plate and screws.
	
Picture 3: Pre-Operative photograph	Picture 4: 12 weeks after Operation
	
Picture 5: 16 weeks after operation. The patient can stand and walk without aids.	Picture 6: 16 weeks after operation. The patient can sit with extended knee and dorsiflex foot.

Illustrations of Case No-2:	
	
Picture 7: Preoperative photograph	Picture 8: 6 weeks after operation
	
Picture 9: The patient can stand 16 weeks after operation.	Picture 10: 16 weeks after operation. The patient can sit and fully plantarflex and dorsiflex foot.

**DISCUSSION**

Distal tibial fractures remain one of the most substantial therapeutic challenges that confront the orthopedic surgeon. Among the different modalities of treatment for distal tibial fractures, MIPO is technically feasible and advantageous in that it minimizes soft tissue compromise and devascularization of the fracture fragments. Locking plate provide stable fixation in distal tibial fractures. Fracture healing is not hampered as there is minimum disturbance of the fracture site. Respect to the soft tissue by indirect reduction and MIPO technique during

operation & early mobilization due to stable fixation improve final outcome.

In our study most of the patients was in age group of 20-40 years (70%) with mean age of 36 years. Road traffic accidents were found to be the commonest mode of trauma (65%). Right lower limb was involved more often (60%) than the left.<sup>7</sup> In this study most of the patients are in age group 31-40 years (50%) with mean age of 41.8 years. And also, road traffic accidents are found to be the commonest mode of trauma (80%). But involvements of both lower limbs are same (50%).

The average operative time was 86.23 min with a range of 70-123 min. The majority of the fractures were operated within 100 min of operative time (90.0%).<sup>6</sup> In this study most of the patient's 6(60%) operated time was 61-90 minutes followed by  $\leq 60$  minutes 4(40.0%). Mean operative time was  $68.0 \pm 12.29$  minutes.

The mean time for radiological union was 21.4 weeks with a range of 16-32 weeks. Only 10% patient developed superficial infections.<sup>6</sup> In this study most of the fractures 6(60%) were united between 12-14 weeks. Mean duration of radiological union was  $14.8 \pm 2.32$  weeks. And also 1(10%) patient developed superficial surgical site infection whose soft tissue Tscherne's grade was 1 and that was managed by empirical oral antibiotics, 1(10%) patient developed ankle stiffness due to lack of proper physiotherapy and also for noncompliance.

Patients could not bear the full weight bearing after 10-12 weeks. No varus deformity was seen after or during weight bearing (Samal et al., 2014). In this study maximum 6(60%) patients beard full weight at time 14-16 weeks. Mean full weight bearing time  $16.6 \pm 2.31$  weeks. No varus deformity was seen but only 2(20%) patients developed valgus deformity (only 5degree) which was happened

during reduction of fracture. In this study 8(80%) patients had no leg length discrepancy, but 2(20%) patients had leg length discrepancy less than 5mm due to comminution of fracture fragments.

Despite the theoretic advantages associated with minimally invasive plating, several studies have reported the rate of delayed union or nonunion for distal tibial fractures with the MIPO technique to be 5% to 17%. But they found there were no nonunions, malunions, or hardware failures, and all patients achieved satisfactory or excellent results. Another study Paluvadi et al. reported 95.06 % excellent result. In this study no patient developed delayed or nonunion and 80% patients had satisfactory result but 20% had unsatisfactory results.

The locking compression plate (LCP) is part of a new plate generation requiring an adapted surgical technique and new thinking about commonly used concepts of internal fixation using plates. Understanding of the mechanical background for choosing the proper implant length and the type and number of screws is essential to obtain a sound fixation.

#### **CONCLUSION:**

Our study showed MIPO with precontoured distal tibial locking plate for extraarticular distal tibial fracture (AO type 43-A) good results in majority of cases. Our limitation is that the sample size is no large enough. 80% of cases return to the routine pre- injury activities without limitations. In terms of subjective evaluation most of the patients had well to excellent outcome. We had 20% unsatisfactory results. But if this technique is practiced more and surgeons become familiar with the technique, we shall have more percentage of satisfactory result. So, we recommend MIPO using precontoured



distal tibial locking plate for extraarticular distal tibial fracture.

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