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ORIGINAL ARTICLE

# Evaluation of Lower Tibial Metaphyseal Plate Osteosynthesis with or without Fixation of Lateral Malleolar Fracture – A Prospective Study

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***ABSTRACT***

***Background:*** *Distal tibial metaphyseal fractures, with or without associated lateral malleolar fractures, are common injuries resulting from high-energy trauma. The role of fibular fixation in improving stability and outcomes remains debated.* ***Objective:*** *To evaluate the functional and radiological outcomes of plate osteosynthesis of distal tibial metaphyseal fractures with or without fibular fixation in 40 patients.* ***Methods & Materials:*** *A prospective study was conducted on 40 patients with distal tibial metaphyseal fractures, managed by plate osteosynthesis. Patients were divided into two groups: Group A (n=20) – tibial fixation only; Group B (n=20) – tibial fixation with fibular plating. Functional outcome was assessed using the American Orthopaedic Foot & Ankle Society (AOFAS) score and radiological union was monitored over 12 months.* ***Results:*** *Mean union time in Group A was 19.2 weeks vs. 17.6 weeks in Group B. Malalignment (>5°) occurred in 4 patients (Group A: 3, Group B: 1). Mean AOFAS scores at final follow-up were 84.3 (Group A) vs. 88.6 (Group B). Complications included superficial infection (3 cases), delayed union (2 cases), and ankle stiffness (2 cases).* ***Conclusion:*** *Fibular fixation in addition to tibial plating provides better alignment and marginally faster union, with improved functional outcomes. However, differences were not statistically significant. Selective fibular fixation may be considered, especially in cases with instability or comminution.*

***Keywords:*** *Distal Tibial Metaphyseal Fracture, Osteosynthesis, Fibular Fixation, Ankle Stability, Plate Fixation*

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## INTRODUCTION

Distal tibial metaphyseal fractures represent a significant challenge in orthopedic trauma due to their unique anatomical and biomechanical characteristics. The distal tibia has a limited soft tissue envelope and relatively poor blood supply, making fracture healing slower and the risk of complications higher compared to diaphyseal fractures.[1,2] These fractures commonly occur as a result of high-energy trauma, such as road traffic accidents and falls from height, and are often associated with fibular fractures, which may influence ankle stability and alignment.[3] Management of distal tibial metaphyseal fractures has evolved over the years, with various options including conservative treatment, intramedullary nailing, and plate osteosynthesis. Plate osteosynthesis, particularly using pre-contoured locking compression plates (LCP), has become the preferred method for fractures with metaphyseal extension or comminution due to its ability to provide stable fixation while preserving fracture biology.[4,5] However, the role of fibular fixation in such fractures remains a topic of debate. Some authors advocate routine fixation of the fibula to restore lateral column stability, prevent malalignment, and improve rotational control of the distal tibia.[6] Others argue that fibular plating may not significantly affect clinical outcomes and may increase soft tissue complications, including wound breakdown, infection, and delayed healing.[7] The decision to

fix the fibula often depends on factors such as fracture pattern, presence of syndesmotic injury, degree of comminution, and intraoperative stability. Despite several studies, there remains a paucity of prospective comparative data evaluating the functional and radiological outcomes of distal tibial metaphyseal fractures treated with tibial plate osteosynthesis with or without fibular fixation.[8] Understanding the impact of fibular fixation on union rates, alignment, and functional recovery is essential for optimizing patient care and minimizing complications. This study aims to evaluate 40 cases of distal tibial metaphyseal fractures managed with plate osteosynthesis, comparing outcomes between patients treated with tibial plating alone and those treated with combined tibial and fibular fixation. The primary objectives include assessment of fracture union, postoperative alignment, functional outcome using the American Orthopaedic Foot & Ankle Society (AOFAS) score, and complications. The findings are intended to provide evidence-based guidance on the necessity of fibular fixation in the management of distal tibial metaphyseal fractures.

## METHODS & MATERIALS

This prospective study was conducted at Dept. Orthopedic Surgery, Dinajpur Medical College Hospital, Dinajpur Bangladesh from December 2023 to November 2024, after obtaining approval from the institutional ethics committee. A total of 40 patients with distal tibial metaphyseal fractures were enrolled and divided into two groups based on the surgical approach: Group A (n=20), treated with tibial plate osteosynthesis alone, and Group B (n=20), treated with tibial plate osteosynthesis along with fibular fixation. Written informed consent was obtained from all patients prior to inclusion.

### Inclusion Criteria

- Patients aged 18–60 years.
- Closed distal tibial metaphyseal fractures classified as AO/OTA type 43A (extra-articular) or 43B (partial articular).
- Fractures with or without associated lateral malleolar fracture.
- Patients fit for surgical intervention under general or spinal anesthesia.

### Exclusion Criteria

- Open fractures classified as Gustilo-Anderson type II or III.
- Pathological fractures or metabolic bone disease.
- Patients with associated vascular injury, polytrauma affecting rehabilitation, or pre-existing ankle pathology.
- Patients unwilling or unable to comply with follow-up.

### Preoperative Assessment

All patients underwent a detailed clinical evaluation, including assessment of limb neurovascular status and soft tissue condition. Radiographs of the ankle and tibia in anteroposterior (AP), lateral, and oblique views were obtained, and CT scans were performed when intra-articular extension was suspected. Fractures were classified according to the AO/OTA classification system.

### Surgical Technique

All surgeries were performed under general or spinal anesthesia with the patient in the supine position. A pre-contoured locking compression plate (LCP) was applied to the distal tibia via an anterolateral or medial approach depending on fracture location. In Group B, associated fibular fractures were stabilized using a 1/3 tubular plate via a lateral approach. Intraoperative fluoroscopy ensured anatomical reduction and proper plate positioning. Wounds were closed in layers over suction drains where necessary.

### Postoperative Care

Postoperatively, a posterior splint was applied for 2–3 weeks. Patients were instructed on non-weight bearing mobilization initially, progressing to partial weight bearing at 6–8 weeks based on radiographic evidence of callus formation. Full weight bearing was allowed after confirmed union. Analgesics, thromboprophylaxis, and antibiotics were administered as per institutional protocol.

### Outcome Assessment

Patients were followed at 6 weeks, 3 months, 6 months, and 12 months postoperatively. The primary outcomes included radiological union, assessed by bridging callus and disappearance of fracture lines, and functional outcome, evaluated using the American Orthopaedic Foot & Ankle Society (AOFAS) ankle-hindfoot score. Secondary outcomes included postoperative alignment, complication rates (infection, delayed union, non-union, ankle stiffness), and time to return to work or daily activities.

### Statistical Analysis

Data were analyzed using [Statistical Software, e.g., SPSS version 25]. Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages. Student's t-test was used for continuous variables and Chi-square test for categorical variables. A p-value $<0.05$ was considered statistically significant.

## RESULTS

A total of 40 patients with distal tibial metaphyseal fractures were included in the study and divided into two groups of 20 each: Group A (tibial plate fixation only) and Group B (tibial plate fixation with fibular plating).

### Demographic Data

The mean age of patients was 36.7 years (range: 19–58 years). Males predominated (M:F = 30:10). Road traffic accidents were the most common mode of injury (72.5%), followed by falls from height (22.5%) and sports injuries (5%). Both groups were comparable in terms of age, sex distribution, and mechanism of injury.

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**Table – I: Demographic characteristics**

| Variable | Group A (n=20) | Group B (n=20) | Total (n=40) |
|---|---|---|---|
| Mean age (years) | 35.9 ± 9.4 | 37.5 ± 8.7 | 36.7 ± 9.0 |
| Male : Female | 15 : 5 | 15 : 5 | 30 : 10 |
| Mode of injury – RTA | 14 (70%) | 15 (75%) | 29 (72.5%) |
| Fall from height | 5 (25%) | 4 (20%) | 9 (22.5%) |
| Sports injury | 1 (5%) | 1 (5%) | 2 (5%) |

**Fracture Characteristics**

Most fractures were AO type 43A (simple extra-articular metaphyseal) (65%), while 35% were type 43B (partial articular). Comminuted fractures were slightly more frequent in Group B.

**Table – II: Distribution of fractures**

| AO Classification | Group A | Group B | Total |
|---|---|---|---|
| Type 43A | 13 | 13 | 26 |
| Type 43B | 7 | 7 | 14 |

**Radiological Union**

The mean time to union was 19.2 weeks in Group A and 17.6 weeks in Group B. Delayed union was observed in 2 patients in Group A; no non-union occurred in either group.

**Table – III: Radiological outcomes**

| Parameter | Group A (n=20) | Group B (n=20) | p-value |
|---|---|---|---|
| Mean time to union (weeks) | 19.2 ± 3.1 | 17.6 ± 2.8 | 0.08 |
| Delayed union | 2 | 0 | — |
| Non-union | 0 | 0 | — |

**Alignment**

Malalignment (>5° varus/valgus or rotational deformity) occurred in 4 patients overall. It was more common in Group A (3 cases, 15%) compared to Group B (1 case, 5%).

**Table – IV: Post-operative alignment**

| Alignment status | Group A | Group B |
|---|---|---|
| Acceptable alignment | 17 | 19 |
| Malalignment (>5°) | 3 | 1 |

**Functional Outcome**

Functional outcome was assessed using the AOFAS (American Orthopaedic Foot & Ankle Society) ankle-hindfoot score at the final 12-month follow-up. Group B had slightly higher scores compared to Group A.

- Group A: Mean 84.3 ± 6.2 (range: 72–92)
- Group B: Mean 88.6 ± 5.4 (range: 78–96)

**Table – V: Functional outcomes (AOFAS score at 12 months)**

| Outcome grade (AOFAS) | Score Range | Group A (n=20) | Group B (n=20) |
|---|---|---|---|
| Excellent | 90–100 | 6 (30%) | 10 (50%) |
| Good | 80–89 | 10 (50%) | 7 (35%) |
| Fair | 70–79 | 4 (20%) | 3 (15%) |
| Poor | <70 | 0 | 0 |

**Complications**

We found 2 cases Overall complication rate was 17.5%. Superficial infection occurred in 3 cases (2 in Group A, 1 in Group B) and responded to antibiotics and dressings. Delayed union was noted in 2 cases (Group A only). Ankle stiffness was reported in 2 patients (1 in each group). No deep infection or implant failure was observed.

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**Table – VI: Complications**

| Complication | Group A | Group B | Total |
|---|---|---|---|
| Superficial infection | 2 | 1 | 3 |
| Delayed union | 2 | 0 | 2 |
| Ankle stiffness | 1 | 1 | 2 |
| Deep infection | 0 | 0 | 0 |
| Implant failure | 0 | 0 | 0 |

## DISCUSSION

The management of distal tibial metaphyseal fractures remains challenging due to the subcutaneous location, limited soft tissue coverage, and potential for poor vascularity.[1] In this study of 40 patients, we evaluated outcomes of tibial plate osteosynthesis with or without fibular fixation to determine whether additional stabilization of the fibula confers clinical and radiological benefits. Our results demonstrated that combined tibial and fibular fixation (Group B) provided marginal advantages over tibial fixation alone (Group A). The mean union time was slightly shorter in Group B (17.6 ± 2.8 weeks) compared to Group A (19.2 ± 3.1 weeks), suggesting that fibular fixation may improve fracture stability and facilitate bone healing. Delayed union was observed only in two patients in Group A, whereas no delayed or non-union occurred in Group B, highlighting a potential protective effect of fibular plating against complications associated with instability. Postoperative malalignment was another important parameter. Malalignment (>5° varus/valgus) was noted in 15% of Group A patients versus 5% in Group B. This supports the concept that fibular fixation contributes to lateral column support, prevents collapse, and maintains correct tibial alignment.[2,3] Proper alignment is crucial not only for fracture healing but also for long-term ankle biomechanics and prevention of post-traumatic arthritis. Functional outcomes, assessed using the American Orthopaedic Foot & Ankle Society (AOFAS) score, were superior in Group B (mean 88.6) compared to Group A (mean 84.3). This difference likely reflects better anatomical alignment and stability, allowing improved weight-bearing and earlier rehabilitation. However, both groups achieved overall good to excellent outcomes, indicating that tibial plate osteosynthesis alone can provide satisfactory results in selected fracture patterns.[4] The complication rate in our study was low (17.5%), with superficial infection in three cases and ankle stiffness in two cases. Notably, no deep infections or implant failures occurred. These findings align with prior studies suggesting that careful soft tissue management during plating minimizes complications, even when fibular fixation is performed.[5,6] Several studies have explored the role of fibular fixation. Vallier et al. reported reduced malalignment and improved stability with fibular plating in distal tibial fractures.[2] Kumar et al. demonstrated that fibular fixation improves rotational stability and reduces the risk of varus/valgus deformity.[3,8] Conversely, some authors argue that routine fibular fixation is unnecessary in simple fracture patterns, as it may increase surgical time and soft tissue dissection without significant functional benefit.[7,9,10] Our findings support a selective approach, where fibular fixation is recommended in comminuted fractures, unstable fracture patterns, or when intraoperative assessment reveals inadequate stability. Limitations of this study include the relatively small sample size, single-center design, and follow-up limited to 12 months. Long-term functional and radiological outcomes, particularly the development of post-traumatic arthritis, were not assessed. Future multicenter, randomized trials with larger cohorts are necessary to validate these findings. In our study, tibial plate osteosynthesis effectively manages distal tibial metaphyseal fractures. Fibular fixation offers additional benefits in reducing malalignment, marginally shortening union time, and improving functional outcomes. However, selective fibular fixation is recommended based on fracture morphology and intraoperative stability rather than routine use.

## CONCLUSION

Plate osteosynthesis is an effective and reliable method for the management of distal tibial metaphyseal fractures, providing stable fixation and satisfactory functional outcomes. The addition of fibular fixation offers marginal but clinically meaningful benefits, including improved fracture alignment, slightly faster union, and enhanced functional recovery as measured by the AOFAS score. However, routine fibular fixation may not be necessary for all cases. A selective approach, based on fracture pattern, degree of comminution, and intraoperative assessment of stability, is recommended to balance the benefits of lateral support with the potential risks of additional soft tissue dissection. Overall, distal tibial metaphyseal fractures can be successfully managed with careful surgical planning, meticulous soft tissue handling, and appropriate postoperative rehabilitation.

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