

Comparative Study of Distal Tibia Fracture Managed by Medial Vs Anterolateral Approach

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Abstract: ***Background:** Distal tibial fractures are challenging because of the subcutaneous location of the bone, limited soft-tissue coverage and frequent metaphyseal or articular involvement. Medial and anterolateral locking compression plate (LCP) fixation are established options, but their clinical and soft-tissue outcomes may differ. **Aim:** To compare the clinical, radiological and functional outcomes of distal tibial fractures treated with medial versus anterolateral LCP fixation. **Materials and Methods:** This prospective comparative study included 60 adults with distal tibial fractures treated at the Department of Orthopaedics, Hind Institute of Medical Sciences, Sitapur. Thirty patients underwent medial LCP fixation and 30 underwent anterolateral LCP fixation. Fracture morphology was assessed using AO/OTA and Rüedi–Allgöwer classifications and soft-tissue injury using the Tscherne–Oestern system. Operative time, blood loss, hospital stay, radiological union, full weight bearing, ankle range of motion, AOFAS score, OMAS category and postoperative complications were evaluated. **Results:** Mean operative time was 104.6 ± 15.1 minutes in the medial group and 92.8 ± 13.4 minutes in the anterolateral group ($p = 0.003$). Blood loss was 218 ± 44 mL versus 178 ± 36 mL ($p = 0.001$), and hospital stay was 8.7 ± 2.2 versus 6.9 ± 1.8 days ($p = 0.008$). Radiological union occurred at 20.8 ± 4.2 versus 17.9 ± 3.5 weeks ($p = 0.02$), while full weight bearing was achieved at 12.1 ± 2.5 versus 10.2 ± 2.0 weeks ($p = 0.04$). Mean ankle range of motion was $52.4 \pm 8.7^\circ$ versus $58.9 \pm 8.3^\circ$ ($p = 0.03$), and mean AOFAS score was 64.3 ± 8.7 versus 71.6 ± 8.4 ($p = 0.01$). Excellent AOFAS outcomes occurred in 40.0% and 60.0% of patients, respectively. Any postoperative complication occurred in 43.3% of medial and 20.0% of anterolateral cases ($p = 0.02$). **Conclusion:** In this cohort, anterolateral LCP fixation was associated with shorter operative time, lower blood loss, shorter hospitalization, earlier union and weight bearing, better ankle motion and higher functional scores, with fewer recorded complications. Approach selection should nevertheless be individualized according to fracture morphology and soft-tissue condition.*

Keywords: distal tibia fracture; locking compression plate; medial plating; anterolateral plating; AOFAS; OMAS; fracture union; postoperative complications

1. Introduction

Distal tibial fractures remain difficult injuries because the distal tibia has a relatively thin soft-tissue envelope and is closely related to the ankle joint. Fracture severity ranges from extra-articular metaphyseal patterns to complex pilon injuries, and treatment must balance anatomical restoration with preservation of local biology and soft tissues. [1–5]

Medial plating has traditionally been used because it provides direct access to the distal tibial surface. However, the medial border is subcutaneous and has limited soft-tissue padding, making wound complications an important concern. The anterolateral approach provides access to the anterior and anterolateral distal tibia and allows plate placement beneath a relatively better soft-tissue envelope. Locking plates and minimally invasive techniques further emphasize biological fixation and reduced soft-tissue disruption. [6–9]

Comparative studies have reported differences in wound complications, operative efficiency and functional recovery between medial and lateral or anterolateral plating, while fracture configuration remains an important determinant of approach selection. [10–13] Biomechanical evidence also suggests that construct behavior varies with fracture alignment, with medial plating showing advantages in selected varus patterns. [14]

The present study compared medial and anterolateral LCP fixation with particular attention to operative parameters, fracture healing, weight bearing, ankle function and postoperative complications.

Aim and Objectives

The aim was to compare the clinical, radiological and functional outcomes of distal tibial fractures managed by medial versus anterolateral LCP fixation. The primary objective was to evaluate functional outcome using AOFAS and OMAS. Secondary outcomes included operative time, blood loss, hospital stay, time to union, time to full weight bearing, ankle range of motion and postoperative complications.

2. Materials and Methods

Study design and setting

This prospective comparative study was conducted in the Department of Orthopaedics, Hind Institute of Medical Sciences, Mau/Ataria, Sitapur, Uttar Pradesh. Sixty patients were included, with 30 treated by medial LCP fixation and 30 by anterolateral LCP fixation. Follow-up was scheduled at 1, 3, 6, 9 and 12 months.

Eligibility criteria

Adults older than 18 years with distal tibial fractures were eligible. Included injuries comprised closed extra-articular AO/OTA 43A1–43A3 fractures with Tscherne–Oestern grade 0 or 1, intra-articular AO/OTA 43B1–43B3 and 43C1–43C3 fractures, Rüedi–Allgöwer type I–III fractures, and distal tibial fractures extending into the diaphysis or para-articular region. Pathological fractures, patients unwilling for surgery, medically unfit patients and open/compound fractures were excluded.

Surgical technique and follow-up

Open reduction and internal fixation was performed using LCPs. For the medial approach, the incision was centered over the medial distal tibia, with protection of the saphenous

nerve and great saphenous vein and minimal periosteal stripping. For the anterolateral approach, the incision was centered around the ankle joint with protection of the superficial peroneal nerve and relevant anterior neurovascular structures. Reduction and plate position were confirmed with fluoroscopy. Postoperative ankle mobilization and controlled progression of weight bearing were used according to fracture healing and fixation stability.

Outcome measures and statistics

Operative duration, intraoperative blood loss, hospital stay, radiological time to union, time to full weight bearing and ankle range of motion were recorded. Functional outcome was assessed with the AOFAS ankle–hindfoot score and OMAS. Continuous variables were summarized as mean $\pm$ standard deviation and categorical variables as frequencies and percentages. Appropriate comparative statistical tests were used as reported in the dissertation, with $p < 0.05$ considered statistically significant.

3. Results

3.1 Baseline characteristics

The two groups were broadly comparable at baseline. The largest age category was 41–50 years. Males constituted 60.0% of the medial group and 53.3% of the anterolateral group. Road traffic accidents were the most common mechanism. AO/OTA and Rüedi–Allgöwer fracture classifications and Tscherne–Oestern soft-tissue grades were similarly distributed.

Table 1: Selected baseline characteristics

Characteristic	Medial LCP n (%)	Anterolateral LCP n (%)
Male	18 (60.0)	16 (53.3)
Female	12 (40.0)	14 (46.7)
Age 41–50 years	9 (30.0)	10 (33.3)
Road traffic accident	20 (66.7)	22 (73.3)
AO/OTA 43A	12 (40.0)	11 (36.7)
AO/OTA 43B	9 (30.0)	10 (33.3)
AO/OTA 43C	9 (30.0)	9 (30.0)
Tscherne–Oestern Grade 0	16 (53.3)	14 (46.7)
Tscherne–Oestern Grade 1	14 (46.7)	16 (53.3)

3.2 Operative and recovery outcomes

Table 2: Operative, healing and functional parameters

Outcome	Medial LCP	Anterolateral LCP	p
Operative time (min)	104.6 $\pm$ 15.1	92.8 $\pm$ 13.4	0.003
Blood loss (mL)	218 $\pm$ 44	178 $\pm$ 36	0.001
Hospital stay (days)	8.7 $\pm$ 2.2	6.9 $\pm$ 1.8	0.008
Time to union (weeks)	20.8 $\pm$ 4.2	17.9 $\pm$ 3.5	0.02
Full weight bearing (weeks)	12.1 $\pm$ 2.5	10.2 $\pm$ 2.0	0.04
Ankle ROM (degrees)	52.4 $\pm$ 8.7	58.9 $\pm$ 8.3	0.03
AOFAS score	64.3 $\pm$ 8.7	71.6 $\pm$ 8.4	0.01

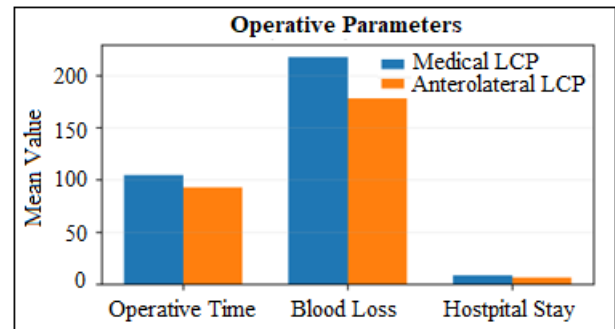


Figure 1: Comparison of operative parameters between the two groups.

3.3 Functional Outcomes

Mean AOFAS score was significantly higher in the anterolateral group (71.6 $\pm$ 8.4) than in the medial group (64.3 $\pm$ 8.7; $p = 0.01$). Excellent AOFAS outcomes occurred in 60.0% of anterolateral cases compared with 40.0% of medial cases, while poor outcomes were recorded only in the medial group. OMAS showed a similar distribution, with excellent outcomes in 53.3% of anterolateral and 33.3% of medial cases.

Table 3: Functional outcome categories according to AOFAS and OMAS

Category	AOFAS Medial %	AOFAS AL %	OMAS Medial %	OMAS AL %
Excellent	40.0	60.0	33.3	53.3
Good	33.3	30.0	36.7	33.3
Fair	20.0	10.0	23.3	13.3
Poor	6.7	0.0	6.7	0.0

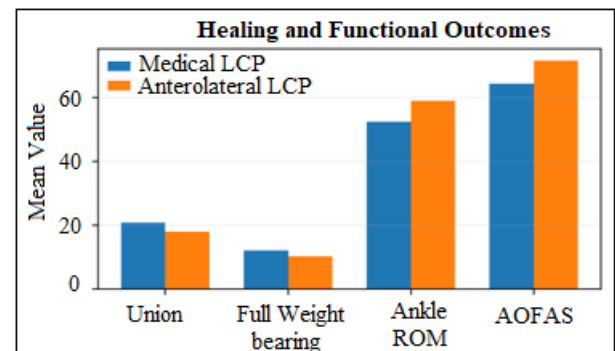


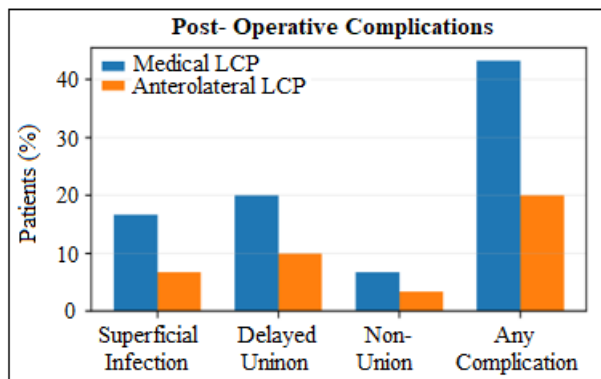
Figure 2: Comparison of healing and functional outcome measures

3.4 Postoperative complications

Superficial infection occurred in 16.7% of medial cases versus 6.7% of anterolateral cases ($p = 0.04$). Delayed union occurred in 20.0% versus 10.0% ($p = 0.03$). Non-union occurred in 6.7% versus 3.3%, without a statistically significant difference ($p = 0.31$). Any complication was recorded in 43.3% of medial cases and 20.0% of anterolateral cases ($p = 0.02$).

Table 4: Postoperative complications

Complication	Medial LCP (%)	Anterolateral LCP (%)	p
Superficial infection	16.7	6.7	0.04
Delayed union	20.0	10.0	0.03
Non-union	6.7	3.3	0.31
Any complication	43.3	20.0	0.02

**Figure 3:** Postoperative complications in the two treatment groups

4. Discussion

The study compared two commonly used approaches for distal tibial LCP fixation in 60 patients. Age, sex, mechanism of injury, fracture classification and soft-tissue injury grade were broadly comparable, providing a reasonable basis for comparison, although the non-randomized design remains a potential source of selection bias.

Anterolateral fixation was associated with shorter operative duration and lower intraoperative blood loss. Operative time was 92.8 ± 13.4 minutes versus 104.6 ± 15.1 minutes ($p = 0.003$), and blood loss was 178 ± 36 mL versus 218 ± 44 mL ($p = 0.001$). These findings are consistent with the rationale of minimizing soft-tissue dissection and facilitating plate placement. [6–9]

Hospital stay was shorter in the anterolateral group (6.9 ± 1.8 vs. 8.7 ± 2.2 days; $p = 0.008$). Radiological union occurred at 17.9 ± 3.5 versus 20.8 ± 4.2 weeks ($p = 0.02$), and full weight bearing at 10.2 ± 2.0 versus 12.1 ± 2.5 weeks ($p = 0.04$). The thesis findings are compatible with the proposed biological benefit of preserving the local soft-tissue and periosteal environment, although the study design does not establish causation.

Functional results also favored the anterolateral group. Mean ankle range of motion was $58.9 \pm 8.3^\circ$ compared with $52.4 \pm 8.7^\circ$ ($p = 0.03$), while mean AOFAS was 71.6 ± 8.4 versus 64.3 ± 8.7 ($p = 0.01$). Individual AOFAS components, including walking distance, gait, sagittal motion, hindfoot motion, stability and alignment, were also higher in the anterolateral group in the thesis. [10–13]

The complication profile showed clinically relevant differences, with superficial infection, delayed union and overall complications more frequent in the medial group. The limited soft-tissue coverage of the medial distal tibia provides a plausible anatomical explanation. However, the

difference in non-union was not statistically significant, and the sample size limits precision for uncommon events.

Approach selection should remain individualized. The thesis cites biomechanical evidence that medial plating may provide greater stiffness in selected varus fracture patterns, whereas no important construct difference was found for simulated valgus patterns.[14] Therefore, fracture morphology, medial column involvement, alignment, soft-tissue status and surgeon experience remain important when selecting the approach.

5. Limitations

The study was single-centre, included only 30 patients per group and used non-randomized allocation. Surgeon experience may have influenced operative parameters. Follow-up was limited to the study period and may not identify late post-traumatic ankle arthritis or implant-related problems. Severe open fractures were excluded, limiting generalizability to high-grade open injuries.

6. Conclusion

In this prospective comparative cohort, anterolateral LCP fixation was associated with shorter operative time, lower blood loss, shorter hospital stay, earlier radiological union and earlier full weight bearing than medial LCP fixation. It also demonstrated greater ankle range of motion, higher mean AOFAS scores and a lower recorded complication rate. These findings support consideration of anterolateral fixation in appropriately selected distal tibial fractures, while fracture morphology and soft-tissue condition should guide the final surgical approach.

Ethical approval

Ethical approval was obtained from the Institute Human Ethical Committee, Hind Institute of Medical Sciences, Mau/Ataria, Sitapur, before study enrolment, as documented in the dissertation. Written informed consent was obtained from participants.

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Nil reported.

Conflict of interest

No conflict of interest was reported.

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