European Journal of Clinical Pharmacy
Print ISSN: 2385-409X **Online ISSN**: 3105-0409
Website: https://farmclin.com/

Original Research Article

Comparison of Outcome of Modified One-Third Tubular Hook Plate with Intramedullary Cannulated Screw versus Locking Compression Plate (LCP) in Lateral Malleolus Fractures

Article History:

***Received**:* 12-11-2025
***Revised**:* 26-11-2025
***Accepted**:* 10-12-2025
***Published**:* 30-12-2025

Name of Author:
[1]Hasan Shahzaib, [2]Tehreem Mehmood, [3]Mohammad Sohail Rafi, [4]Muhammad Younas, [5]Sajjad Hussain

Affiliation: *[1]Dr Ziauddin Hospital Clifton Karachi*
[2]Dr Ziauddin Hospital Clifton Karachi
[3]Dr Ziauddin Hospital Clifton Karachi
[4]Dr Ziauddin Hospital Clifton Karachi
[5]Dr Ziauddin Hospital Clifton Karachi

Corresponding Author:

Abstract: ***Background:*** A significant proportion of all ankle injuries involve the lateral malleolus and its surgical management is one aspect of ankle injuries that is controversial for a great number. One-third tubular plates, which are also economic, can sometimes cause problems with soft tissue. Although Locking Compression Plates (LCPs) might be more expensive, compared to other options, they yield superior biomechanical results, and preserve soft tissues, thus being beneficial in osteoporotic fractures. Aim: To evaluate and compare the clinical, functional and intra-operative results of modified one-third tubular hook plate with intramedullary screws to Locking Compression Plates (LCPs) management of lateral malleolus fractures. ***Methodology:*** In a randomized control trial conducted over 6 months at Ziauddin Hospital in Karachi, 80 patients presenting with acute, closed, isolated lateral malleolus fractures (Danis–Weber types A, B, or C) following low- to moderate-energy trauma were enrolled. All subjects were randomized to the modified hook-plate intervention group (n=40) or the LCP group (n=40). Olerud Molander Score (OMS) and American Orthopaedic Foot & Ankle Society (AOFAS) score were utilized for six-month postoperative functional outcomes. SPSS version 25.0 was used for statistical analysis by setting statistical significance as $p \leq 0.05$. ***Results:*** At six months, overall functional outcomes were comparable i.e., OMS (84.2 vs. 80.3; $p = 0.023$) and AOFAS (85.9 vs. 82.2; $p = 0.020$) scores, with no statistically significant differences. However, in Weber B fractures, patients treated with LCP demonstrated significantly higher OMS and AOFAS scores. Additionally, the LCP group had fewer Tscherne Grade III soft tissue injuries across all fracture types. However, the hook plate group demonstrated shorter operation times (43.5 vs. 46.9 minutes in Weber B; $p = 0.034$) and reduced tourniquet durations, indicating procedural efficiency. ***Conclusion:*** LCPs offer better functional and soft tissue outcomes, especially in Weber B fractures, and may be the preferred implant when resources allow. However, modified hook plates with intramedullary screws offered comparable overall functional results with greater surgical efficiency, supporting their use in resource-limited settings. Implant choice should be individualized based on fracture type, patient factors, and healthcare context.

Keywords: Lateral malleolus fracture, Locking Compression Plate (LCP), one-third tubular hook plate, intramedullary screw, functional outcome, orthopaedic trauma, Danis–Weber classification.

INTRODUCTION

Ankle fractures are especially those that involve the lateral malleolus are the most frequently treated orthopaedic conditions of which account for approximately 9% of all fracture cases in the world (1). Since the lateral malleolus, made up of the distal fibula are essential for the stability of the ankle joint, any damage to the lateral malleolus would be critical (2).

One-third tubular plates have been traditionally the procedure of choice for stabilizing displaced lateral malleolar fractures since they are simple, inexpensive, and easily available (3). However, wound problems and irritation by the implant, in addition to the visibility of hardware, had led to the development of modified techniques such as the addition of a distal hook to the plate to improve fixation in osteoporotic or comminuted fractures (4). The altered one-third tubular hook plate, commonly complemented with an intramedullary cannulated screw, is gaining traction, based on its biomechanical advantages such as rotational stability and increased stability in small distal fragments (2).

Nowadays, owing to their stable fixation and application of the minimally invasive plate osteosynthesis technique (MIPO), locking compression plates (LCPs) are used for the treatment of different fractures (distal fibular fracture) (5). The LCP has become an improvement in fracture stabilization, especially beneficial to osteoporotic patients because of its stability and the reduced need for periosteal stripping (6). There are two types of LCP plates, LCP metaphyseal plate and LCP distal fibula plate. Fixed angle constructs form part of the LCPs that are designed within a framework of limiting hardware failure and non-union especially in the management of complex or comminuted fractures. However, the cost of LCP implants remains a significant problem in Pakistan and other LMICs where money could mean a barrier to high-tech orthopaedics (7).

These days, ankle fractures are a common occurrence in Pakistan, brought about by an increase in road traffic accidents and industrial injuries with studies indicating that ankle and foot traumas account for about 12-15% of orthopaedic admissions to tertiary care centres (8). With affordability and other resources at hand, the choice of cost-effective and user-friendly modified implants has grown significant (9). Although they cost more, research worldwide show that LCPs are linked to less infections and less need for surgical procedures (10). However, relative efficacy, complications, and patient outcome of these implants compared to modified tubular plates have not been adequately explored yet in local studies in resource-limited settings (11). In addition, use of cannulated screws intramedullary with the hook plate scan reduce plate prominence and make minimally invasive insertion possible, thus minimizing the soft-tissue integrity – a critically important aspect for the diabetic and the elderly population common in Pakistan (12).

Studies have indicated that the functions of LCPs may be improved with biomechanical strength but using modified hook plates coupled with intramedullary screws can produce comparable results at relatively lower cost linked with lesser risks to soft tissue (13). The choice of implant left to the decision of the fracture, however, the patient's state of health, bone quality, and their finances play a role in that decision (14). Considering the increased incidence rate of orthopaedic trauma in Pakistan as a result of the increase in urbanization, increased density of traffic and lax safety standards, special evidence-based recommendations are essential for Pakistani healthcare (12). Consequently, the purpose of this study is to determine clinical and functional outcomes of modified one-third tubular hook plates and intramedullary cannulated screws relative to locking compression plates in patients with lateral malleolus fractures, with a view to guiding surgical discretion for Pakistan.

MATERIALS AND METHODS

Study Design and Settings

The study was conducted in the Orthopaedic Department of Ziauddin Hospital, Clifton, Karachi. The total duration of the study was six months[1.1], commencing after the approval[2.1] of the research synopsis. This research followed a randomized controlled trial (RCT) design to ensure a robust comparison between the two treatment modalities. A random allocation technique was employed, whereby all eligible patients presenting during the study period were enrolled until the required sample size was achieved.

Sample Population

The sample size was calculated to be 80 patients, with 40 participants allocated to each group. This estimation was based on a 95% confidence level and 80% power of the test, considering an expected excellent outcome percentage of 36.67% for open reduction and internal fixation (ORIF) using the modified one-third tubular hook plate, and 80% for the locking compression plate (LCP) used in distal fibula fractures, as reported in previous studies. Participants were selected based on specific inclusion and exclusion criteria. The inclusion criteria comprised patients of both genders, aged between 18 and 70 years, classified as ASA physical status I or II, and diagnosed with type A or type B lateral malleolus fractures according to the Danis–Weber classification. Patients were excluded if they presented with compound (open) fractures, had associated fractures elsewhere in the body, or sustained injuries due to traffic accidents, bicycle or pedestrian collisions, or falls from a height other than the same level. This exclusion was performed in order to create a more homogeneous study population and minimize confounding related to soft-tissue damage, systemic injury burden, and staged fixation protocols.

Preoperative Preparation

All patients were taken to the operating theatre where appropriate anesthesia was administered. In the

supine position, standard aseptic techniques including scrubbing, painting, and draping of the operative area were performed. A tourniquet was applied to maintain a bloodless field and minimize intraoperative blood loss.

Surgical Procedure [3.1]1: Modified One-Third Tubular Hook Plate with Intramedullary Cannulated Screw

For patients undergoing fixation with the modified one-third tubular hook plate and intramedullary cannulated screw, the lateral malleolus was approached using an open technique via a posterolateral incision. The fracture site was exposed, and anatomical reduction was achieved using bone clamps. Fixation was performed using a contoured one-third semi-tubular plate or a 3.5 mm reconstruction plate. Adequate periosteal stripping was carried out to facilitate proper hardware placement. Fracture reduction was achieved with the help of clamps and two parallel Kirschner wires, carefully avoiding entry into the ankle joint space.
Surgical Procedure 2: Locking Compression Plate (LCP)

For patients assigned to the LCP fixation group, a direct lateral skin incision was made, extending distally beyond the tip of the lateral malleolus. The incision was placed either slightly anterior or posterior to avoid direct overlap between the plate and the skin incision. Superficial dissection proceeded through the intermuscular plane between the peroneus tertius anteriorly and the peroneus brevis and longus muscles posteriorly. Closed reduction and reversal of the injury mechanism were used to realign the fracture. The lateral malleolus was anatomically reduced and temporarily held in place using a bone holder and Kirschner wire. Following reduction, the LCP was positioned over the lateral aspect of the fibula. A power drill was used to place the most proximal screw first to achieve initial compression, followed by the insertion of subsequent screws sequentially down to the distal end. Throughout the procedure, anteroposterior, lateral, and mortise views were obtained under fluoroscopic guidance to confirm accurate fracture reduction, appropriate screw length, and optimal implant positioning.

Wound Closure and Postoperative Immobilization
Upon completion of fixation in both surgical techniques, the operative wounds were thoroughly irrigated with sterile saline solution and closed using 3/0 Prolene sutures. A below-knee posterior splint was then applied to immobilize the ankle joint and support early healing during the postoperative period.

Postoperative Protocols
Postoperatively, all patients received injectable antibiotics, analgesics, and adequate intravenous fluids as part of the immediate recovery regimen. A compression bandage was applied along with a below-knee posterior slab to maintain limb stability and support. The operated limb was elevated to minimize postoperative swelling and enhance venous return. Within the first 24 hours following surgery, anteroposterior and lateral radiographs of the ankle were performed to confirm implant positioning and fracture alignment. The first wound inspection was conducted on the third postoperative day to assess for any signs of infection or complications. Sutures were removed after the twelfth postoperative day. Following suture removal, a below-knee plaster of Paris (POP) cast was applied, and patients were discharged with specific instructions for non-weight-bearing mobilization for a duration of six weeks. The hospital stay duration reflected institutional practice, with patients commonly retained until suture removal to ensure wound surveillance and compliance with follow-up. Functional evaluation of the ankle joint was carried out after two months using the Olerud and Molander Ankle Scoring System, a validated tool to assess recovery based on parameters such as pain, stiffness, swelling, stair-climbing ability, running, jumping, and work or daily activities. All postoperative clinical and radiological data were retrieved from the hospital's electronic medical records system for consistency and accuracy.

Data Analysis
All collected data were entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0. The normality of quantitative variables was assessed using the Shapiro-Wilk test. Quantitative variables such as age, body mass index (BMI), and functional scores were described using mean and standard deviation (Mean ± SD). If the data did not follow a normal distribution, the median and interquartile range (IQR) were calculated instead.

Qualitative variables including gender, American Society of Anesthesiologists (ASA) status, smoking history (defined as more than five cigarettes per year), diabetes mellitus (fasting blood sugar >126 mg/dL), hypertension (blood pressure >140/90 mmHg), and functional outcome scores were presented as frequencies and percentages.

Comparative analysis of functional outcomes between the two treatment groups was performed using the independent t-test. To control for potential confounders, the data were stratified according to age, gender, ASA status, smoking status, diabetes, hypertension, and BMI. Post-stratification, either the Chi-square test or Fisher's exact test was applied as appropriate. A p-value of ≤0.05 was considered statistically significant for all analyses.

RESULTS

Demographic Distribution

The demographic distribution of the study participants showed a predominance of male patients in both groups, with 65% in the Modified Hook Plate with Screw group and 60% in the LCP Distal Fibula Plate group, reflecting an overall male majority of 62.5%. The age distribution was relatively balanced, with the largest proportion of patients (47.5%) falling within the 31–50-year age range, followed by 28.7% in the 51–70 age group and 23.8% aged 18–30 years, indicating a concentration of fractures among middle-aged adults. In terms of BMI, the majority of patients in both groups were either overweight (37.5%) or had normal weight (36.3%), while 20% were classified as obese and a smaller proportion (6.3%) were underweight. This suggests that most lateral malleolus fractures in this cohort occurred in individuals with relatively higher body mass indices, which could potentially influence fracture mechanics and post-operative recovery.

Table 1: Demographic Characteristics of Participants in Both Groups

Variable	Category	Modified Hook Plate + Screw (n = 40)	LCP Distal Fibula Plate (n = 40)
Gender	Male	26 (65.0%)	24 (60.0%)
	Female	14 (35.0%)	16 (40.0%)
Age (years)	18–30	10 (25.0%)	9 (22.5%)
	31–50	18 (45.0%)	20 (50.0%)
	51–70	12 (30.0%)	11 (27.5%)
BMI (kg/m²)	<18.5 (Underweight)	2 (5.0%)	3 (7.5%)
	18.5–24.9 (Normal)	14 (35.0%)	15 (37.5%)
	25–29.9 (Overweight)	16 (40.0%)	14 (35.0%)
	≥30 (Obese)	8 (20.0%)	8 (20.0%)

Clinical Profiling

The clinical profile of patients in both groups showed comparable characteristics. The majority of patients were classified as ASA-I, with 65% in the Modified Hook Plate with Screw group and 70% in the LCP Distal Fibula Plate group, indicating that most participants were of relatively low perioperative risk. Smoking prevalence was notably high in both groups, reported in 72.5% and 75% respectively, reflecting a significant risk factor that could potentially influence bone healing and surgical outcomes. The incidence of diabetes was low, affecting only 2.5% of patients in the Modified Hook Plate group and 5% in the LCP group, suggesting minimal confounding from this metabolic condition. Similarly, hypertension was reported in a small fraction of patients .5% in the hook plate group and 12.5% in the LCP group indicating that most participants did not have significant cardiovascular comorbidities.

Table 2: Clinical Characteristics of Participants

Variable	Category	Modified Hook Plate + Screw (n = 40)	LCP Distal Fibula Plate (n = 40)
ASA* Status	ASA I	26 (65.0%)	28 (70.0%)
	ASA II	14 (35.0%)	12 (30.0%)
Smoking	Yes	29 (72.5%)	30 (75.0%)
	No	11 (27.5%)	10 (25.0%)
Diabetes	Yes	1 (2.5%)	2 (5.0%)
	No	39 (97.5%)	38 (95.0%)
Hypertension	Yes	3 (7.5%)	5 (12.5%)
	No	37 (92.5%)	35 (87.5%)

*The ASA (American Society of Anaesthesiologists) is a physical status classification system used to assess and communicate a patient's pre-anaesthesia medical comorbidities. ASA-I refers to a normal healthy patient. ASA-II refers to a patient with mild systemic disease (e.g., well-controlled diabetes or hypertension, smoking without COPD).

Impact of Surgical Technique on Tscherne Soft Tissue Injury Grades

The findings illustrate the distribution of Tscherne soft tissue injury grades (Grades I, II, III, and No Injury) across the three Danis-Weber fracture types (Type A, B, and C) for patients treated with either the modified hook plate with cannulated screw or the LCP distal fibula plate. In Weber Type A fractures, a greater number of patients in the

modified hook plate group exhibited Grade I and Grade III injuries compared to the LCP group, which showed no Grade III injuries and a higher proportion with no soft tissue involvement. This difference reached statistical significance (p = 0.043), indicating a meaningful variation in soft tissue injury severity between the two treatment methods in Type A fractures. In Weber Type B fractures, similar trends were observed, with more severe soft tissue injuries (Grade III) occurring in the modified hook plate group. Although both groups had comparable numbers of mild to moderate injuries (Grades I and II), the hook plate group again showed a higher proportion of Grade III cases, contributing to a statistically significant difference (p = 0.032). Weber Type C fractures, though smaller in sample size, revealed a consistent pattern; the modified hook plate group had a higher frequency of Grade III injuries, whereas the LCP group exhibited no cases of Grade III injuries. This difference also reached statistical significance (p = 0.011), suggesting that across all fracture types, the LCP group was associated with fewer severe soft tissue complications. These findings highlight the potential soft tissue preservation advantage of the LCP fixation technique over the modified hook plate method in managing lateral malleolus fractures.

Table 3: Distribution of Danis–Weber Fracture Types and Tscherne Soft Tissue Injury Grades with Percentages

Weber Type	Tscherne Grade	Modified Hook Plate (n, %)	LCP Distal Fibula Plate (n, %)	P-value
Type A (n=25)	Grade I	4 (30.8%)	3 (25.0%)	0.043
	Grade II	2 (15.4%)	3 (25.0%)	
	Grade III	2 (15.4%)	0 (0.0%)	
	No Injury	5 (38.5%)	6 (50.0%)	
Type B (n=40)	Grade I	4 (19.0%)	3 (15.8%)	0.032
	Grade II	2 (9.5%)	3 (15.8%)	
	Grade III	2 (9.5%)	0 (0.0%)	
	No Injury	13 (61.9%)	13 (68.4%)	
Type C (n=15)	Grade I	2 (25.0%)	2 (28.6%)	0.011
	Grade II	2 (25.0%)	2 (28.6%)	
	Grade III	2 (25.0%)	0 (0.0%)	
	No Injury	2 (25.0%)	3 (42.9%)	

Surgical Outcomes by Fixation Method in Danis-Weber Fracture Types

The table 4 presents a comparative analysis of operative parameters between patients treated with the Modified Hook Plate with Screw and those treated with the Locking Compression Plate (LCP) across the Danis-Weber Type A, B, and C fracture subgroups. Statistically significant differences were observed in all measured parameters, indicating a consistent advantage in favour of the Modified Hook Plate with Screw. In Type A fractures, patients managed with the Modified Hook Plate with Screw experienced shorter operation delays (9.0 vs. 8.5 hours, P = 0.042), reduced operation times (43.4 ± 6.6 vs. 46.4 ± 10.0 minutes, P = 0.038), and significantly less tourniquet usage (36.1 ± 6.9 vs. 40.4 ± 9.9 minutes, P = 0.031) compared to those treated with the LCP. For Type B fractures, all parameters—including plate length—demonstrated statistically significant differences, with the Modified Hook Plate with Screw again associated with slightly shorter operative times and less implant length (5 holes, range 5–6) versus the LCP group (6 holes, range 5–6; P = 0.041). In Type C fractures, the Modified Hook Plate with Screw continued to show superior surgical performance, with significantly shorter operation delays, operation times, and tourniquet durations. These findings suggest that the Modified Hook Plate with Screw technique may offer notable surgical efficiencies over the Locking Compression Plate, including reduced intraoperative time, less tourniquet dependency, and potentially less extensive hardware use—factors that may contribute to improved soft tissue preservation and operative efficiency.

Functional Outcomes

The adjusted functional outcome analysis at 6-month follow-up revealed that, overall, patients treated with the Locking Compression Plate exhibited numerically higher scores in both the Olerud Molander Score (OMS) and the American Orthopaedic Foot & Ankle Society (AOFAS) assessments when compared to those managed with the Modified Hook Plate with Screw, although the differences did not reach statistical significance (OMS: 83.3 vs 81.1, p = 0.132; AOFAS: 85.2 vs 83.0, p = 0.109). When stratified by fracture classification, no significant differences were noted between the two groups in Weber A fractures for either the OMS (81.5 vs 81.5, p = 0.990) or AOFAS scores (83.4 vs 83.6, p = 0.934), suggesting functional equivalence in this simpler fracture type.

Commented [1]: 6-month follow-up short (late arthritis/hardware issues missed, as noted in limitations…)

Table 4: Surgical Parameters by Fracture Type and Fixation Group

Subgroup	Modified Hook Plate with Screw Group	Locking Compression Plate (LCP) Group	P-Value
Danis-Weber Type A			
Operation delay (hrs)	9.0 (4.5–129.0)	8.5 (5.0–105.0)	0.042[a]
Operation time (min)	43.4 ± 6.6	46.4 ± 10.0	0.038[b]
Tourniquet time (min)	36.1 ± 6.9	40.4 ± 9.9	0.031[b]
Plate length (holes)	5	5	
Danis-Weber Type B			
Operation delay (hrs)	7.5 (5.0–147.5)	7.0 (4.5–104.0)	0.027[a]
Operation time (min)	43.5 ± 7.1	46.9 ± 7.4	0.034[b]
Tourniquet time (min)	35.7 ± 6.8	39.4 ± 6.8	0.022[b]
Plate length (holes)	5(5–6)	6(5–6)	0.041[a]
Danis-Weber Type C			
Operation delay (hrs)	8.5 (3.75–103.0)	7.0 (4.0–79.5)	0.015[a]
Operation time (min)	44.9 ± 3.4	46.1 ± 2.9	0.028[b]
Tourniquet time (min)	35.4 ± 3.5	38.1 ± 3.4	0.020[b]
Plate length (holes)	6(6–7)	6(6–7)	0.044[a]

[a] Mann–Whitney U test, [b] Independent-sample t-test

However, in patients with Weber B fractures, statistically significant differences favored the Locking Compression Plate. OMS scores were higher in the LCP group (84.2) compared to the Modified Hook Plate group (80.3), with p = 0.023. Similarly, the AOFAS scores showed superior performance in the LCP group (85.9 vs 82.2), reaching statistical significance (p = 0.020). These findings indicate that, in the context of Weber B injuries, the LCP technique may offer improved functional recovery by 6 months postoperatively. In patients with Weber C fractures, both techniques yielded comparable functional outcomes, with no statistically significant differences observed in either OMS (84.0 vs 83.5, p = 0.885) or AOFAS scores (86.4 vs 85.2, p = 0.791), suggesting that fracture complexity may mitigate the differential advantage of fixation technique. Collectively, the adjusted data reinforce that while both fixation strategies are broadly effective, the Locking Compression Plate may be preferable for Weber B fractures, offering statistically and clinically meaningful gains in functional recovery at intermediate-term follow-up.

Table 5. Functional Outcomes at 6-Month Follow-Up Between Modified Hook Plate with Screw and Locking Compression Plate (LCP)

Fracture Type	Score Type	Modified Hook Plate with Screw (Mean ± SD)	Locking Compression Plate (Mean ± SD)	*p* Value
Overall	OMS	81.1 ± 6.9	83.3 ± 7.0	0.132
	AOFAS	83.0 ± 6.2	85.2 ± 8.3	0.109
Weber A	OMS	81.5 ± 6.5	81.5 ± 8.0	0.990
	AOFAS	83.4 ± 6.1	83.6 ± 10.0	0.934
Weber B	OMS	80.3 ± 6.5	84.2 ± 7.8	0.023*
	AOFAS	82.2 ± 5.7	85.9 ± 7.5	0.020*
Weber C	OMS	83.5 ± 8.3	84.0 ± 8.2	0.885
	AOFAS	85.2 ± 7.9	86.4 ± 8.1	0.791

Note: $p < 0.05$ indicates statistical significance.

Complications

Two patients with the Weber A fracture treated with one-third tubular plate was diagnosed superficial infection clinically during the inpatient period. They were treated with regular dressing change and intravenous antibiotics. The infection was controlled avoiding hardware removal. At the final follow-up, the patients had a ROM of 50°-60°. One patient of LCP group with Weber A fracture was found non-union. No deep infection or loss of reduction was found in the remaining patients until the final follow-up. None developed superficial peroneal nerve injury.

DISCUSSION

This study was designed to evaluate and compare the functional as well as surgical outcomes of modified one-third tubular hook plates and intramedullary cannulated screws versus LCPs with regards to lateral malleolus fractures as methods of fixation. In particular, the trial revealed that although the functional outcome from either procedure was similar, the patients with Weber B fractures in the LCP group had statistically better results. Specifically,

Commented [2]: Reanalysis is highly suggested. Totals do not match n=40/group. P values not accurate without details.

Commented [3]: Length of plate: why LCP requires 1 extra hole, correlation if any, with soft tissue outcomes, discuss fracture configuration vs plate length, interfragmentary lag screws,.

Will be a strength if includes, hardware prominence , cost effectiveness vs length of the plate, as the study empahsize LMICs regionally.

Commented [4]: No stratification by group/type; underpowered detection.

Commented [5]: Post op protocol mentions, first wound inspection on 3rd post op day, and DC on or after 12 post op day? When was this superficial infection disgnosed, what type of antibiotics were continued or initiated?

Commented [6]: If it means removal of implants, then the followup of study is 6 months, when were the implants removed? Status of fracture healing?

Commented [7]: Non union in 6 months?

the Olerud Molander Score (OMS) was 84.2 in the LCP group compared to 80.3 in the hook plate group ($p = 0.023$), and AOFAS scores were 85.9 versus 82.2 respectively ($p = 0.020$). The results suggest that LCPs are related to superior functional outcome, especially in cases of fractures displaying increased degrees of rotational instability. This finding confirms the results of a biomechanical investigation by Lebaron et al., (2024), who reported that locking plates promote angular stability and make them a suitable choice to treat the metaphyseal and osteoporotic bone fractures (15).

In contrast, the modified hook plate group demonstrated significant intraoperative advantages. For instance, the operation time was consistently shorter across all Weber fracture types, with the most notable difference in Weber B fractures—43.5 ± 7.1 minutes versus 46.9 ± 7.4 minutes ($p = 0.034$). Tourniquet time and operative delay were also reduced in this group. These efficiencies may translate to lower anaesthesia exposure, reduced infection risk, and better overall surgical throughput. Similar findings were reported by Patel et al., (2024), who observed that modified hook plates, when combined with intramedullary screws, led to faster surgical times without compromising fracture stability in simple fracture patterns (9). The results regarding soft tissue injury are clinically significant. The LCP group consistently showed fewer Tscherne Grade III soft tissue injuries across all fracture types ($p = 0.043$ in Type A, $p = 0.032$ in Type B, and $p = 0.011$ in Type C). This outcome is likely due to the minimally invasive application of LCPs, which preserve periosteal blood supply—a point emphasized by Hossain et al., (2023), who found that LCPs reduce soft tissue complications due to their angular stability and limited periosteal disruption (16).

Despite the LCP group showing numerically superior OMS and AOFAS scores overall (OMS: 83.3 vs. 81.1; AOFAS: 85.2 vs. 83.0), these differences did not reach statistical significance ($p = 0.132$ and $p = 0.109$, respectively). This raises an important clinical question on justification of additional cost of LCPs when the absolute functional gains are modest and often not statistically significant (17). This debate is echoed in studies by Zhang et al., (2024), who concluded that while LCPs might lower the reoperation and hardware failure rates, their high cost must be weighed against marginal improvements in functional outcomes. Another aspect worth examining is the distribution of patient demographics. The majority of patients in both groups were male (62.5% overall) and middle-aged (47.5% were between 31–50 years), with most patients falling into the overweight or obese BMI category (57.5%). Obesity is a known risk factor for poor surgical outcomes due to delayed wound healing and increased mechanical stress on implants (5). However, the study does not report any stratified analysis to assess if BMI influenced the functional outcomes, which could be a limitation.

The low rates of diabetes (2.5% and 5%) and hypertension (7.5% and 12.5%) in the sample population suggest that the study participants were relatively healthy, which might have positively influenced healing rates and functional recovery. However, since Pakistan has a growing elderly and diabetic population, the exclusion of such high-risk patients limits the generalizability of these findings to broader clinical contexts (10). With respect to plate length and hardware usage, the modified hook plate group required shorter implants (e.g., 5 holes vs. 6 in Weber B fractures, $p = 0.041$), indicating a possible reduction in material costs. This is clinically relevant in LMIC settings, where hardware affordability is a substantial barrier. Recent studies emphasized that affordability often dictates surgical choices more than ideal clinical protocols, particularly in public sector hospitals in South Asia (18,19).

In terms of surgical technique, both fixation methods involve open reduction, yet the hook plate approach entails more periosteal stripping. This may partly explain why soft tissue injuries were higher in this group, as corroborated by Kadar et al., (2022), who stressed that aggressive periosteal handling can compromise healing in osteoporotic fractures. The study used validated outcome measures (OMS and AOFAS), enhancing the reliability of its findings. However, a 6-month follow-up may not capture late complications such as implant loosening or post-traumatic arthritis. Long-term data, as explored by Mehraban et al., (2024), would better delineate durability and complication profiles of both techniques (20,21).

From a biomechanical standpoint, while the study briefly references the rotational stability advantages of hook plates with intramedullary screws, it does not explore construct fatigue over time. Research by Zyskowski et al., (2022) has demonstrated that locking plates, due to their fixed-angle construct, maintain strength even in osteoporotic or comminuted bone, whereas non-locking constructs may weaken under cyclical load, particularly in high BMI individuals or those returning early to weight-bearing. This becomes particularly relevant in the South Asian context, where early mobility is often culturally prioritized, and prolonged immobilization is poorly adhered to, necessitating implants that are resilient to early stress (22). A broader public health perspective highlights that ankle fractures are increasing due to urbanization, road traffic accidents, and industrial trauma (23). In such settings, the ability to rapidly treat fractures in resource-limited environments becomes essential. The modified hook plate, being cheaper and easier to stock, could be the

preferred first-line approach in rural or under-resourced hospitals where LCPs may be either unavailable or financially inaccessible.

Limitations

The sample size, although statistically powered, remains modest and may limit generalizability, particularly across diverse healthcare institutions in Pakistan. Secondly, the follow-up duration of six months may not capture late complications such as implant failure, hardware removal, or post-traumatic arthritis, which often manifest beyond this period. Thirdly, the exclusion of high-risk populations, including polytrauma patients, diabetics, and elderly patients with osteoporotic bone, limits applicability to more complex real-world scenarios. Additionally, the absence of cost-analysis data, radiographic union rates, and long-term quality-of-life metrics restricts the study's utility in policy formulation and economic evaluation.

CONCLUSION

The findings of this study suggest that the LCP offers superior outcomes in most clinically relevant parameters, particularly in terms of functional recovery and soft tissue preservation—most notably in Weber B type lateral malleolus fractures, where statistically significant improvements were observed in both Olerud Molander (84.2 vs. 80.3; $p = 0.023$) and AOFAS scores (85.9 vs. 82.2; $p = 0.020$). Furthermore, LCPs were consistently associated with fewer severe soft tissue complications across all Weber fracture types. However, the modified one-third tubular hook plate with intramedullary cannulated screw remains a viable and cost-effective alternative, offering notable advantages in surgical efficiency, including shorter operative times and reduced tourniquet use—factors that are highly relevant in resource-constrained settings. These results highlight that while LCPs may be the preferred option from a clinical efficacy standpoint, the hook plate system continues to play an important role in pragmatic surgical decision-making, particularly in low-resource environments.

Further research should extend follow-up and recruit larger and more multi-centred cohorts to gain a better long-term outcome and complications understanding for both fixation procedures. The performance of subsequent levels of research on direct and indirect economic estimates, imaging results, and patient-reported experiences will contribute to the assessment of overall effectiveness of surgery. In addition, studying outcomes in particular risk group categories – diabetics, smokers as well as elderly osteoporotic patients – could provide further reasonable clinical observations. In terms of public health and policy, it would be wise to suggest the use of simplified fixation like the modified hook plate in trauma protocols to rural and district hospitals to expand reliability of orthopaedic treatment. As a result, the training programs must make every effort to ensure the surgeons remain on the same level and can acquire expertise on both the implant systems and it should be left to them to choose the strategy appropriate on case by case basis available resource considerations.

REFERENCES

1. Cho B ki, Kim J beom, Choi SM. Efficacy of hook-type locking plate and partially threaded cancellous lag screw in the treatment of displaced medial malleolar fractures in elderly patients. Arch Orthop Trauma Surg. 2022;142(10):2585–96.
2. Sheth U, Fernandez CE, Morgan AM, Henry P, Nam D. Are two plates better than one? A systematic review of dual plating for acute midshaft clavicle fractures. Shoulder Elb. 2022;14(5):500–9.
3. Yang CY, Hong WC, Tsai MT, Hsu JT. Biomechanical comparison of plate, intramedullary screw, and headless compression screw fixation in Danis–Weber type B lateral malleolar fractures. J Orthop Surg Res. 2025;20(1):402.
4. Penning D, Jonker CAL, Buijsman R, Halm JA, Schepers T. Minifragment plating of the fibula in unstable ankle fractures. Arch Orthop Trauma Surg. 2023;143(3):1499–504.
5. Zhang J, Luo R, Chen J. The fibular intramedullary nail versus plate fixation for ankle fractures in adults: a systematic review and meta-analysis of randomized controlled trials. J Orthop Surg Res. 2024;19(1):542.
6. I. Abulsoud M, Elmarghany M, Zakaria AR, Alshal EA, Moawad M, Elzahed EA, et al. Internal Fixation for Unstable Distal Ulnar Fractures by 2.7 mm Semitubular Hook Plate. Adv Orthop. 2024;2024(1):5663025.
7. Mooya S, Kakakhel M, El-Amien A, Anto P, Khel M. Anti-Glide Plate Fixation for Lateral Malleolus Fractures by Minimally Invasive Technique in Geriatric Patients. Cureus. 2022;14(3).
8. Shahid S, Saleem S, Niazi SNK, Inam KU, Naqshband MS, Masood F. Comparison of Union Rate of Tibial Diaphyseal Fractures Treated with Intramedullary Interlocking (IIL) Nails Versus Dynamic Compression Plate (DCP). Ann Punjab Med Coll. 2024;18(2):166–9.
9. Patel R, McCarthy K, Christensen J, Jacobs B, Karsch J, Sephien A, et al. Cost analysis and clinical outcomes of anatomic pre-contoured locking versus conventional plates for distal fibula ankle fractures. Eur J Orthop Surg Traumatol. 2024;34(2):959–65.
10. Shah FA, Ali MA. Outcome of proximal femur shaft fractures in school going children treated with locking compression plates. Pakistan J Med Sci. 2021;37(5):1353.
11. Anwar R, Tanveer OF, Haider T, Hannan MA, Cheema MUR. Functional Outcome of Surgical

Management of Trimalleolar Fractures. Pakistan J Med Heal Sci. 2023;17(01):472.
12. Tahir MA, Ahmed RD, Hassan AR, Ahmed S, Khalid HA, Khandan A. Pilon Fracture Management: Distal Tibial Locking Plate Vs Ilizarov. Indus J Biosci Res. 2025;3(4):554–8.
13. Gahr P, Matthis M, Schleese L, Fischer DC, Mittlmeier T. Modern anatomical locking plates are associated with increased postoperative wound complications and unplanned surgical revisions compared to standard tubular plates in the management of unstable ankle fractures: a comparative cohort study in 595 patients. Patient Saf Surg. 2024;18(1):1–9.
14. Zawam SH, Mabrouk MG, El-Desouky MA. Lateral malleolar fractures Weber Type A and B: does percutaneous intramedullary screw confer a solid alternative to the traditional neutralization plate? Int Orthop. 2022;46(9):2127–34.
15. Lebaron M, Maman P, Volpi R, Flecher X. Full weight bearing after internal fixation of isolated distal fibular fractures with anatomically contoured locking plates: Our institutional experience. Injury. 2024;55:111476.
16. Hossain MI, Alam MI, Sagir MG, Rahman MA, Hossain MY. Outcome and Evaluation of Distal Tibial Close Fractures with Locking Compression Plate (LCP): A Prospective Study (MIPO) Approach. SAS J Surg. 2023;4:350–5.
17. Patel S, Dionisopoulos SB. Current concepts in ankle fracture management. Clin Podiatr Med Surg. 2024;41(3):519–34.
18. Dhillon MS, Rajnish RK, Kumar P, Sharma S, Singh GP, Srivastava A. A comparison of outcomes of locking versus non-locking plate fixation for the distal fibula fractures: a systematic review and meta-analysis. Eur J Orthop Surg Traumatol. 2024;34(1):75–89.
19. Pflüger P, Braun KF, Mair O, Kirchhoff C, Biberthaler P, Crönlein M. Current management of trimalleolar ankle fractures. EFORT open Rev. 2021;6(8):692–703.
20. Mehraban N, Lew AR, Foran IM, Lee S, Bohl DD, Hamid KS. Lateral locking plate fixation of simple weber B fibula fractures without a lag screw yields excellent radiographic results. Foot Ankle Spec. 2024;17(2):131–6.
21. Kadar A, Tommasini SM, Singla A, Beitler BG, Moushey AM, Baumgaertner MR. Mini-blade plate to obtain length across lateral malleolus fractures: surgical technique and biomechanical evaluation. Indian J Orthop. 2022;1–7.
22. Zyskowski M, Wurm M, Greve F, Zehnder P, Pflüger P, Müller M, et al. A prospective randomized study comparing functional outcome in distal fibula fractures between conventional AO semitubular plating and minimal invasive intramedullary "photodynamic bone stabilisation." J Clin Med. 2022;11(23):7178.
23. Testa EJ, Walsh D, Patel D, Kahan LG, Modest J, Schilkowsky R, et al. Supination Adduction Vertical Medial Malleolar Fracture Fixation with Buttress Plating vs a Novel Screw-Only Construct: A Cadaveric Biomechanical Study. Foot Ankle Int. 2022;43(6):810–7.