

FUNCTIONAL AND RADIOLOGICAL OUTCOME OF USE OF FIBULAR HOOK PLATE IN MANAGEMENT OF ANKLE FRACTURES - A PROSPECTIVE STUDY

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ABSTRACT

Background: Bimalleolar ankle fractures are common intra-articular injuries requiring stable fixation to restore joint congruity and function. Comminuted fractures of the lateral malleolus present technical difficulties, particularly when the distal fragment is small and the fixation purchase is limited. This study aimed to evaluate the functional and radiological outcomes following surgical management of ankle fractures and to document the associated complications during follow-up. **Materials and Methods:** This prospective study included 20 patients treated at the Department of Orthopaedics, Government Rajaji Hospital, and Madurai Medical College between January 2022 and January 2024. Patients underwent operative fixation and were clinically and radiologically assessed using standardized scoring systems at regular follow-up intervals. **Result:** Most patients were aged 41–50 years (10, 50%) and were male (16, 80%). The right ankle was involved in 11 cases (55%), and road traffic accidents were the leading cause (12 cases, 60%). Supination–external rotation fractures were the most frequent (12, 60%), and Type B fractures predominated (14, 70%). Good objective outcomes were observed in 14 patients (70%), fair in 5 (25%), and poor in 1 (5). OMAS scores demonstrated favorable functional recovery in the majority of patients. Superficial infection occurred in four patients (20%), and implant removal was required in two (10%). Nonunion and talar malalignment were each observed in one patient (5%), with no deep infection or arthritis detected. **Conclusion:** Operative fixation resulted in satisfactory functional and radiological outcomes with an acceptable complication rate. Careful reduction, stable fixation, and structured rehabilitation contributed to consistent fracture union and the restoration of ankle stability.

INTRODUCTION

Ankle fractures are common intra-articular injuries of the lower limbs. They involve bone and ligament damage and can disturb the ankle mortise if not properly reduced. Malalignment of the talus within the tibial plafond changes joint loading and may lead to chronic pain and degenerative arthritis.^[1] The Lauge-Hansen classification is still commonly used because it explains ankle fracture patterns based on the position of the foot and direction of the applied force. These mechanical factors produce consistent sequences of bone and ligament injuries, which help clinicians understand the fracture pattern and plan treatment.^[2]

Restoration of the fibular length, rotation, and alignment is necessary for ankle stability. Even minimal lateral talar displacement reduces tibiotalar contact area. A.O. principles emphasize anatomical reduction, stable fixation, and early mobilization.^[3] Weber A fractures and selected Weber B fractures can be managed conservatively when the mortise remains stable.^[4] Surgical fixation is indicated in cases of talar instability, fibular shortening, comminution, or syndesmotic injury. Spiral and oblique fractures are usually treated with an interfragmentary screw and a neutralisation tubular plate, with satisfactory union after ORIF in unstable ankle fractures.^[5]

Distal comminuted fractures of the lateral malleolus are difficult to treat. When the distal fragment is

small or located within 2 cm of the fibular tip, screws or a one-third tubular plate may not obtain adequate purchase.^[6] Inadequate fixation can result in fibular shortening, posterior displacement, syndesmotic malreduction, talar tilt, and persistent instability.^[7] Loss of fibular length alters ankle biomechanics and affects long-term function. Conventional plates may not provide secure fixation in comminuted distal fractures.

The lateral malleolar hook plate was introduced to improve fixation in such cases.^[8] The distal hook engages the fracture fragment and helps maintain the fibular length. The plate has a pre-contoured valgus angle and allows controlled restoration of alignment.^[9] It is particularly useful in fractures in which the distal fragment is too small for conventional fixation. Although the implant has mechanical advantages, there is limited prospective evidence assessing functional recovery and radiological alignment after hook plate fixation in bimalleolar ankle fractures classified according to AO–Danis–Weber and Lauge–Hansen systems. Most available reports are retrospective or include small sample sizes without standardized scoring systems. Therefore, this study aimed to evaluate the functional and radiological outcomes of fibular hook plate fixation for bimalleolar ankle fractures. Functional assessment was performed using the Olerud and Molander score. Radiological evaluation included fibular length, talar tilt, and ankle mortise congruity after the surgical treatment.

MATERIALS AND METHODS

This prospective observational study was conducted from January 2022 to January 2024 at Government Rajaji Hospital and Madurai Medical College, Madurai, and included 20 patients with bimalleolar ankle fractures who were admitted to the Department of Orthopaedics and Traumatology. Approval was obtained from the Institutional Ethics Committee, and written informed consent was obtained from all participants.

Inclusion and exclusion criteria

Patients aged 20–60 years with bimalleolar ankle fractures were selected for the study. Patients with active systemic infections, open fracture dislocations, local skin problems around the ankle, or a history of prior ankle arthrodesis were excluded.

Methods: Demographic data, including age, sex, side of injury, and mode of injury, were recorded upon admission. The interval between injury and surgery was documented. Fractures were evaluated using standard anteroposterior and lateral ankle radiographs and classified according to the AO and Lauge–Hansen classification systems. The preoperative assessment included the evaluation of fracture displacement, syndesmotic injury, talar shift, and medial clear space widening.

All patients underwent open reduction and internal fixation using a fibular hook plate for the lateral malleolus. Additional fixation of the medial malleolus was performed when indicated. Intraoperative findings, such as periosteal interposition, comminuted fragments, and associated soft tissue injury, were documented. Reduction quality was assessed intraoperatively under fluoroscopic guidance, with fibular shortening and posterior displacement measured in millimetres.

Postoperative evaluation included clinical examination and serial radiography to assess fibular length, talar tilt, talar shift, mortise congruity, and fracture union. Functional outcomes were measured using the Olerud and Molander scoring system, a validated patient-reported outcome measure assessing pain and functional status. Complications such as infection, nonunion, malalignment, implant removal, and syndesmotic instability were recorded during follow-up visits. Fracture union was defined radiographically by cortical continuity across at least three cortices. Talar tilt and mortise congruity were assessed using standard radiographic parameters. The primary outcome was functional recovery assessed by OMAS at final follow-up.

Statistical analysis: Data were analysed using SPSS v29. Categorical variables are expressed as frequencies and percentages. No inferential statistical analysis was performed due to the small sample size.

RESULTS

Most patients were aged 41–50 years (10, 50%). Males predominated (16, 80%), and the right ankle was more frequently involved (11, 55%). Road traffic accidents were the main cause of injury (12, 60%), followed by self-fall or twisting (6, 30%) [Table 1].

Table 1: Demographic and injury characteristics

Variable	Category	N (%)
Age	21–30	4 (20%)
	31–40	3 (15%)
	41–50	10 (50%)
	51–60	3 (15%)
Sex	Male	16 (80%)
	Female	4 (20%)
Side	Right	11 (55%)
	Left	9 (45%)
Mode of injury	Road Traffic Accident	12 (60%)
	Self-fall / Twisting	6 (30%)
	Fall from Height	2 (10%)

Supination–external rotation was the most frequent fracture pattern (12, 60%). Type B fractures were the most common according to the AO–Danis–Weber classification (14, 70%) [Table 2].

Table 2: Distribution of fracture patterns according to Lauge–Hansen and AO–Danis–Weber classifications (n = 20)

Fracture Classification Distribution	Category	N (%)
Lauge-Hansen Classification	SER	12 (60%)
	PER	4 (20%)
	SAD	2 (10%)
	PAB	2 (10%)
AO–Danis–Weber Classification	Type A	2 (10%)
	Type B	14 (70%)
	Type C	4 (20%)

Footnotes: SER – Supination–external rotation; PER – Pronation–external rotation; SAD – Supination–adduction; PAB – Pronation–abduction; Type A – fracture below syndesmosis; Type B – at syndesmosis level; Type C – above syndesmosis. Percentages are calculated based on total sample size (n=20).

Supination–external rotation fractures showed the highest proportion of favorable outcomes, with four patients (20%) achieving excellent and four patients (20%) achieving good scores. Pronation–external

rotation fractures also showed good results, with three patients (15%) in the excellent category. One poor outcome was observed, which occurred in the supination–external rotation group (1, 5%) [Table 3].

Table 3: Subjective OMAS distribution according to Lauge–Hansen classification (n=20)

Pattern	OMAS score			
	Excellent	Good	Fair	Poor
SER (n=12)	4 (20%)	4 (20%)	3 (15%)	1 (5%)
PER (n=4)	3 (15%)	1 (5%)	0	0
SAD (n=2)	1 (5%)	1 (5%)	0	0
PAB (n=2)	0	1 (5%)	1 (5%)	0

Footnotes: SER – Supination–external rotation; PER – Pronation–external rotation; SAD – Supination–adduction; PAB – Pronation–abduction

Most patients achieved good clinical and radiological outcomes, with 14 (70%) scoring between 0 and 3. Fair results were observed in five patients (25%),

whereas only one patient (5%) had a poor objective score [Table 4].

Table 4: Overall functional outcome

Grade	N (%)
Good (0–3)	14 (70%)
Fair (4–6)	5 (25%)
Poor (7–12)	1 (5%)

Supination–external rotation fractures showed the highest proportion of good objective outcomes (9, 45%). All pronation–external rotation fractures had

good results (4, 20%). Only one poor outcome was recorded, which occurred in the supination–external rotation group (1, 5%) [Table 5].

Table 5: Objective clinical and radiological outcome according to Lauge–Hansen fracture pattern

Pattern	Clinical and Radiological Outcome		
	Good N (%)	Fair N (%)	Poor N (%)
SER (n=12)	9 (45%)	2 (10%)	1 (5%)
PER (n=4)	4 (20%)	0	0
SAD (n=2)	1 (5%)	1 (5%)	0
PAB (n=2)	1 (5%)	1 (5%)	0

Footnotes: SER – Supination–external rotation; PER – Pronation–external rotation; SAD – Supination–adduction; PAB – Pronation–abduction

The most common complication was superficial infection with or without skin necrosis, observed in four patients (20%). Implant removal was required in two patients (10%). Nonunion, talar tilt, and talar

shift were each noted in one patient (5%). No cases of deep infection, malunion, or arthritis were observed [Table 6].

Table 6: Postoperative complications and implant removal

Variable	Category	N (%)
Complication	Superficial infection ± skin necrosis	4 (20%)
	Deep infection	0 (0%)
	Nonunion	1 (5%)
	Talar tilt	1 (5%)
	Talar shift	1 (5%)
	Malunion	0 (0%)
	Arthritis	0 (0%)
	Implant removal	2 (10%)

DISCUSSION

This study showed that most patients were middle-aged men with right ankle involvement, commonly due to road traffic accidents. Supination–external rotation and Type B fractures were predominant. Functional outcomes were good to excellent on subjective and objective assessments. Superficial infection was the most common complication, with few cases requiring implant removal and minimal major adverse events.

In our study, most patients were middle-aged males. The right ankle was more involved than the left. Road traffic accidents were the primary cause. Supination–external rotation and Type B fractures were the predominant patterns. Similarly, Han et al. found that in a large series of patients (mean age 42.3 years), 1517 males aged 16–50 years accounted for 38% of the cases. Right-side fractures were 2003 (50.7%) of the total fractures. Danis–Weber Type B predominated (1640, 42%), followed by Type A (31%) and Type C (19%).^[10] Juto et al. reported that in a large study, the mean age was 56.3 years, with a peak incidence at 60–69 years (238/100,000 person-years). Females comprised 58.4% of the patients. Right ankle involvement was observed in 53.3% of the patients. Type B fractures predominated (66.2%), followed by Type A (19.8%) and Type C (10.6%).^[11] Type B fractures represent the most common pattern, and right ankle involvement is frequently reported. These findings align with established epidemiological distributions of ankle fractures. The superficial infection rate was within reported ranges for ankle ORIF and did not adversely affect final functional scores.

In this study, supination–external rotation fractures showed the most favorable subjective and objective outcomes. The majority of patients achieved good functional outcomes, and pronation–external rotation fractures consistently demonstrated satisfactory objective recovery. Consistent with our findings, Hemanth et al. reported that supination–external rotation was the most common fracture type (34, 37.8%) in 90 patients. Mean OMAS improved from 47.5 ± 17.9 to 81.7 ± 16.2 ($p < 0.001$). At 6 months, 72 patients (80%) had good-to-excellent outcomes, and 42 (46.7%) had excellent outcomes.^[12] Lambers et al. found that in 50 pronation–external rotation fractures, 44/48 (92%) had good-to-excellent AOFAS scores and 44/49 (90%) had good-to-excellent FAAM scores at 21 years. Radiographic osteoarthritis was present in 24/49 (49%) patients, yet

functional outcomes remained favorable.^[13] Therefore, both supination–external rotation and pronation–external rotation fractures usually result in good to excellent functional recovery. These findings are consistent with the favourable functional outcomes observed in the present study.

Our study showed that superficial infection was the most frequent complication. Implant removal was required in two patients. Single cases of nonunion and talar malalignment were observed, but deep infection, malunion, and arthritis were not observed. Similarly, Thangarajah et al. found that among 50 patients, 15 (30%) developed complications. Superficial infection was most common (7, 14%), followed by deep infection (5, 10%). Fixation failure occurred in two (4%) patients. Implant removal was required in three patients (6%).^[14] Macera et al. found that complications occurred in 136 (36%). Superficial infection was observed in 5 (1.3%), deep infection in 13 (3.4%), malunion in 9 (2.4%), and post-traumatic osteoarthritis in 19 (5.0%) patients. Hardware removal was required in 17 (4.5%).^[15] These studies also report superficial infection as a common complication and document occasional implant removal, deep infection, and malunion. Their complication patterns and rates were comparable, supporting the safety profile observed in our study.

Limitations

The study had a small sample size from a single centre and a short follow-up period. No comparison group was included. Variability in fracture configuration and rehabilitation compliance may have influenced functional outcomes.

CONCLUSION

Most patients showed good functional and radiological recovery after the surgical fixation of bimalleolar ankle fractures. Supination–external rotation and Type B fractures were common and responded well to treatment. Most patients had satisfactory subjective and objective scores, and major complications were uncommon. Superficial infection was the most frequent problem, but serious adverse events were rare. Proper fracture reduction, stable fixation, and structured postoperative management were associated with high rates of fracture union and restoration of ankle stability. Further research with larger groups, longer follow-up, and comparative methods is needed to better understand the long-term results and improve treatment strategies.

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