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Assessment of union and ankle function following bimalleolar fracture fixation with medial CC screw and lateral malleolar plate

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Abstract
Background: Bimalleolar ankle fractures require precise anatomical reduction and stable fixation to ensure optimal functional recovery. The combination of a medial cancellous (CC) screw and a lateral malleolar plate is widely used, yet outcome data on union rates and postoperative function remain clinically relevant.
Objective: To assess radiological union and ankle function following bimalleolar fracture fixation using a medial CC screw and a lateral malleolar plate in a cohort of 18 patients.
Methods: This prospective study included 18 patients with acute bimalleolar fractures treated with open reduction and internal fixation. Medial malleolar fixation was achieved using a partially threaded CC screw, while the lateral malleolus was stabilized with a plate. Patients were followed for 6 months. Radiographic union was evaluated on standard ankle views, and functional outcomes were measured using the American Orthopedic Foot and Ankle Society (AOFAS) Ankle–Hind foot Score along with clinical range-of-motion assessment. Postoperative complications were recorded.
Results: Radiographic union was achieved in 17 of the 18 patients within 10–14 weeks. One patient demonstrated delayed union but progressed without the need for revision surgery. The mean AOFAS score at 6-month follow-up indicated good to excellent outcomes in most patients. Ankle range of motion approached near-normal values in those without complications. Minor complications included two cases of superficial infection and one case of hardware discomfort, all of which were managed conservatively.
Conclusion: Fixation of bimalleolar fractures using a medial CC screw and lateral malleolar plate provides stable construct integrity, high union rates, and favorable functional outcomes in this sample of 18 patients. The technique remains a reliable option for restoring ankle stability and promoting early rehabilitation.

Keywords: Bimalleolar fracture, cc screw, lateral malleolar plate, lauge- hansen classification, ankle function

Introduction
Ankle fractures are among the most common lower-limb injuries managed in Orthopaedics, with a growing preference for operative treatment in recent decades to restore joint anatomy and biomechanics. [1, 2]
It constitute approximately 9% of all fractures, of which bimalleolar fractures represent about 60%, with an incidence of 187 per 100,000 population and a bimodal distribution affecting younger males and older females. They are the third most common fracture overall and the most frequent fracture in athletes. [3-5]
Bimalleolar fractures involve both the medial and lateral malleoli of the distal tibia and fibula, which most frequently result from supination–external rotation mechanisms, while eversion injuries may produce more extensive damage. [3]
Isolated malleolar fractures account for nearly two-thirds of cases, whereas bimalleolar fractures occur in about one-fourth and trimalleolar fractures in 5–10% of patients; open fractures are uncommon (2%). [1]
Given the ankle's role in weight bearing and locomotion, accurate reduction and stable fixation are essential for functional recovery.
The combination of a medial cancellous screw and lateral malleolar plating is commonly employed, [1, 6, 7] and evaluation of union rates and functional outcomes remains clinically important.

Need for the Study
Bimalleolar ankle fractures are common intra-articular injuries affecting ankle stability and long-term function, and improper management may lead to stiffness, malunion, or post-traumatic arthritis. [1, 2]
Open reduction and internal fixation (ORIF) is the current standard treatment to restore joint congruity and biomechanics; however, functional outcome and time to union may vary depending on fixation methods and patient factors. [1, 3]
The combination of medial cancellous screw fixation and lateral malleolar plating is widely practiced, yet regional data regarding radiological union, functional outcome, and complications remain limited, especially in small institutional settings. [1, 4]
Assessment of clinical and radiological outcomes in local patient populations helps validate existing techniques, identify complications, and improve surgical protocols and rehabilitation strategies. [5]
Hence, this study was undertaken to evaluate radiological union and functional outcome following fixation of bimalleolar fractures using medial CC screw and lateral malleolar plate.

Objectives
- To assess the time to radiological union following fixation of bimalleolar ankle fractures with a medial CC screw and lateral malleolar plate.

- To evaluate postoperative ankle function using a standardized functional scoring system.
- To document postoperative complications.

Methodology

Study Design: This was a prospective cohort study.

Study Setting: The study was conducted in the Department of Orthopedics at K.V.G. Medical College & Hospital,

Study Period: 18 months from March 2024 to September 2025

Study Population: Patients presenting with acute bimalleolar ankle fractures who were treated surgically with open reduction and internal fixation in our institute

Inclusion criteria

- Age ≥18 years
- Bimalleolar fractures - Lauge Hansen supination external rotation type, supination adduction type, pronation external rotation type injuries.
- Patients willing for surgery and follow up, with minimum follow up of at least 6 months.

Exclusion criteria

- Patients with open or pathological fracture.
- Tri malleolar fractures.
- Bimalleolar fractures with syndesmotic injuries.
- Polytrauma patients with ipsilateral lower-limb injuries affecting assessment

Study procedure

Preoperative Assessment

- All patients underwent a detailed clinical evaluation, including history of injury, mechanism of trauma, side involved, and functional limitation of the affected ankle.
- Radiological assessment was performed using standard anteroposterior (AP) and lateral views of the ankle, and CT scan of the affected ankle.
- Injuries were classified according to the Lauge-Hansen classification system based on radiographic findings.

Fig 1: Pre operative clinical and radiological images

Surgical Technique

- Patient was placed in a floating lateral position with sandbag underneath ipsilateral buttock after giving anaesthesia.
- Lateral malleolus fixation: Through the lateral approach the lateral malleoli was fixed with one third tubular plate/tubular locking plate/3.5 mm DCP plate/distal fibular locking plate.
- Medial malleoli fixation: Patient was then rolled back to supine position. Vertical incision was taken over medial malleoli which was reduced and held with clamps and fixed with 4mm CC screws.
- Post operatively below knee POP slab was applied with ankle in plantigrade position.

Fig 2: Intra operateive images

Postoperative Rehabilitation

- Post operatively on 12th day wound inspection was done and sutures were removed in all the patients.
- At 6 weeks follow up pop slab was removed and weight bearing was started along with ankle range of motion exercises.
- Regular follow ups were then done at 3 months, 6 months, 1 year with American Orthopaedic Foot and Ankle Society [AOFAS] Ankle Hind foot score along with clinical range of motion assessment

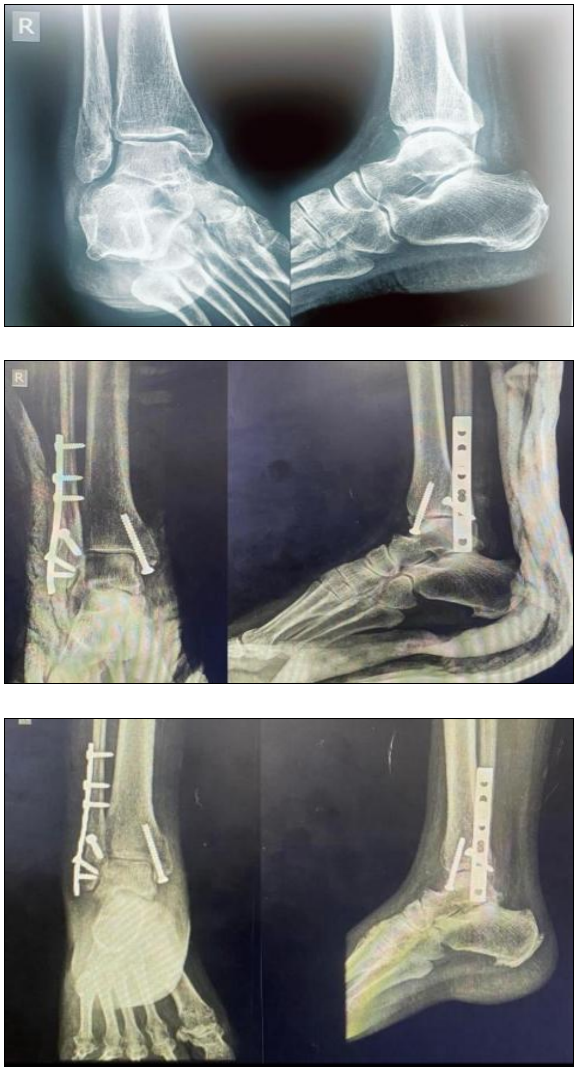


Fig 3: Case 1- pre operative, post-operative and 12 weeks radiographic images of a 60 years old female patient

Fig 4: Case 2- pre operative, post operative radiographic images of a 42 years old female patient

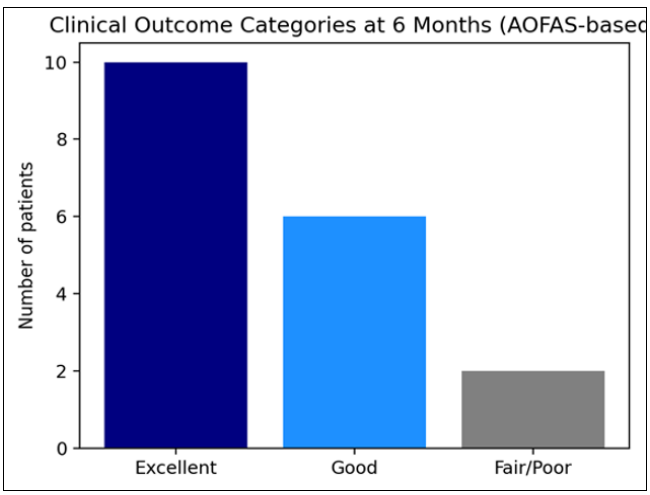
Fig 5: Case 2- pre operative, post operative radiographic images of a 32 years old male patient

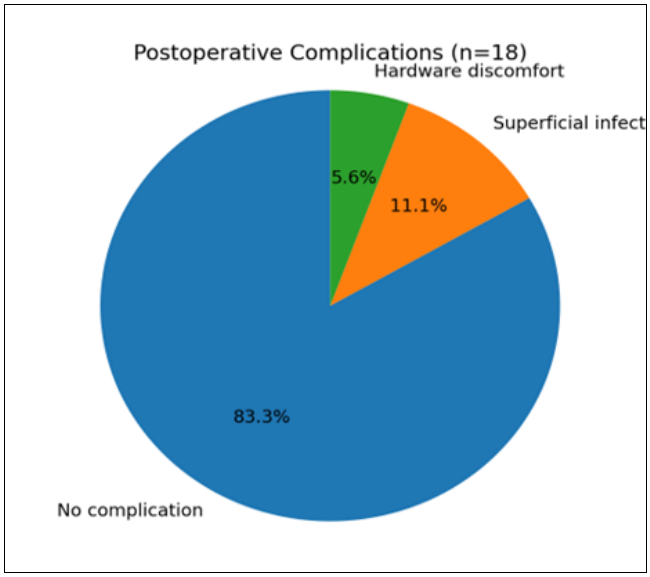
Outcome Measures

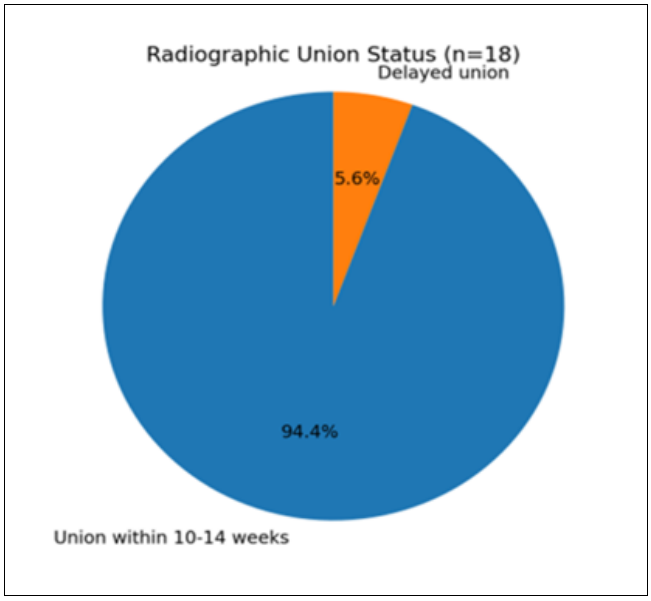
- Radiological assessment of fracture union was performed using standard anteroposterior, lateral, and mortises ankle radiographs. Union was defined as the presence of bridging callus and loss of fracture line visibility.
- Functional assessment of ankle was done using American Orthopaedic Foot and Ankle Society [AOFAS] Ankle Hind foot score along with clinical range of motion assessment.

Results

- **Mean age:** 45.74 years
- Male (56%) > Female (44%)
- **Mode of Injury:** RTA (65.42%), followed by fall due to slipping (21.15%)
- **Common Injury pattern:** Denis Weber type A (62%)







Discussion

- Mean age of patients presenting with bimalleolar ankle fractures in our study was 45.74 years, with majority being ≥40 years. Similar observations were made by Vala GP *et al* [7] (43.83 years), Gola KP *et al* [8] (49.63 years), and Koppula N *et al* [9] (42 years). However, one study from Maharashtra observed mean age younger than our study. [1]
- Most of the patients were male (56%), which is in accordance with previous studies [1,7,9], except one study from Puducherry, which observed female dominance [8].
- Most common mode of injury in our study was RTA (65.42%), which is in agreement with previous literature. [6,7,9,10]
- Danis Weber type A (62%) was the commonest injury pattern observed in our study, which was also observed by Vala GP *et al* [7], whereas, Kapadia SS *et al* [11] observed Type B (43.75%) as the most common pattern of injury.
- Radiographic union was achieved in 17 patients (94.44%) within 10–14 weeks, while one patient demonstrated delayed union which progressed without need for revision surgery. Similarly, most of the patients achieved union by 14 weeks in the study by Kapadia SS *et al* [11]. Another study by Gola KP *et al* [8] observed that mean time for fracture union was 10.97±2.52 weeks.
- The mean AOFAS score in our study at 6-month follow-up revealed Excellent score in 10 patients (55.6%), Good in 6 patients (33.3%) and Fair/Poor in two patients (11.1%). One similar study from Gujarat observed that mean ankle foot score was Excellent in 25% of patients, Good in 46.87%, Fair in 15.62% and Poor in 12.05% of patients. [11]
- Ankle range of motion approached near-normal values in those without complications. Minor complications in our study included two cases of superficial infection and one case of hardware discomfort, all of which were managed conservatively. One similar study from Nashik reported superficial skin infection in 13.33% patients, wound maceration in 13.33% patients, deep infection in 6.66% of patients, failed reduction in 6.66% patients, and 6.66% of patients developed pressure sore. [1]

Limitation: Single centre study and Small Sample size

Conclusion

Bimalleolar fracture fixation using a medial cancellous cannulated (CC) screw combined with lateral malleolar plate provides reliable fracture union and satisfactory restoration of ankle function. The majority of patients in our study achieved timely radiological union with good to excellent functional outcomes and low complication rates. This construct offers stable fixation, allows early mobilization, and represents an effective and reproducible method for the management.

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