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Clinical Outcome in a Series of Trimalleolar Fractures

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Abstract

Trimalleolar fractures, characterized by involvement of the lateral, medial, and posterior malleoli, present a complex challenge that necessitates precise surgical intervention to restore ankle stability and function. This study evaluates the outcomes of surgical management in 20 patients aged 18 to 70 years with displaced trimalleolar fractures, highlighting the increased incidence in the older population. Pre-operative planning included comprehensive assessments with basic investigations, radiological studies (X-rays in anteroposterior, lateral, and mortise views), and CT scans for evaluating posterior malleolar fragments and cases of initial ankle subluxation. Surgical techniques employed were tailored to individual fracture patterns and included plating, cannulated screws, and tension band wiring, with particular attention to the posterior malleolus. Functional outcomes were assessed using the American Orthopaedic Foot & Ankle Society (AOFAS) Ankle-Hindfoot Score, and radiological results were monitored through serial follow-up X-rays. The average follow-up duration was 12 months, during which patients demonstrated favourable functional recovery, achieving an average AOFAS score of 87.7 out of 100 at the 12-month mark. Post-operative radiological evaluations indicated successful intra-articular reduction and fixation across all cases, with progressive fracture healing observed at follow-up visits. This case series emphasizes the critical role of precise anatomical reduction, stable fixation, and a structured rehabilitation program in the successful treatment of trimalleolar fractures. Furthermore, it underscores the importance of individualized treatment plans and multidisciplinary approaches in optimizing patient outcomes.

Keywords: *Ankle Fracture, Clinical Outcome, Cannulated Screw Fixation, Posterior Malleolus, Poster Lateral Approach, Trimalleolar Fracture, Unstable Ankle.*

Introduction

Ankle fractures account for 10% of bone injuries and have been on the rise in recent years. Trimalleolar fractures accounting for 7-10% of ankle fractures [1], pose a substantial challenge to orthopaedic surgeons due to their intricate anatomy and high risk of complications. They occur most commonly due to twisting injuries and the incidence increases with added comorbidities like diabetes mellitus and osteoporosis. The term "trimalleolar" refers to the involvement of three critical anatomical structures that play a vital role in maintaining ankle joint stability. These fractures are commonly classified using various scoring systems, with the Lauge-Hansen classification being one of the most widely recognized. Trimalleolar fractures typically fall under the SEIV (supination-external rotation type IV) or PEIV (pronation-external rotation type IV) categories, reflecting the disruption of the ankle mortise, which is essential for normal foot and ankle biomechanics. This disruption can significantly impact the overall functionality and stability of the ankle, highlighting the importance of accurate diagnosis and appropriate surgical management. Because of the complexity of the injury, managing trimalleolar fractures is a substantial difficulty

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for orthopaedic surgeons and the requirement for firm fixation and accurate anatomical reduction to restore joint congruency and function. The management of trimalleolar fractures has evolved significantly, with advances in surgical techniques, implant designs, and rehabilitation protocols. However, the clinical outcome of these fractures remains variable, influenced by factors such as fracture severity, surgical approach, and patient compliance. Nonoperative treatment is generally not recommended for these fractures due to the high risk of malunion, nonunion, and post-traumatic arthritis. Instead, surgical intervention is the preferred approach to achieving optimal outcomes. ORIF is the standard surgical procedure used to address trimalleolar fractures to achieve a better functional outcome [2].

The primary goals of surgical management are to restore the anatomy of the ankle, achieve stability of the fracture fragments, and allow for early mobilization and rehabilitation. Successful outcomes are heavily dependent on the surgeon's ability to achieve anatomic reduction and stable fixation, as well as the implementation of a comprehensive postoperative rehabilitation program. The complexity of trimalleolar fractures requires an in-depth knowledge of the biomechanics of the ankle joint, the fracture pattern, and the principles of fracture fixation.

The posterior malleolus fracture warrants special attention. Historically, the posterior malleolus fragment was often left untreated or managed conservatively if it constituted less than 25% of the articular surface [3]. The size of the posterior malleolar intra-articular fragment about the percentage of the total articular surface is used as a criterion to assess if the ankle joint is unstable and the need for fixation of the third malleolar fragment posteriorly [4]. The fixation of the posterior malleolus can be challenging due to its location and the choice of surgical approach—whether through an open posterolateral approach or percutaneous techniques [5]. This article aims to provide the clinical outcome of trimalleolar fractures, including complication rates and return to activity. Also, by analysing the existing evidence, this study seeks to inform orthopaedic surgeons, researchers, and healthcare professionals on the optimal management strategies for trimalleolar fractures, ultimately improving patient outcomes and reducing the burden of this debilitating injury.

Materials and Methods

This retrospective case series involved 20 patients who underwent surgery for trimalleolar fractures at Sree Balaji Medical College and Hospital from 2021 to 2023. A thorough review of case sheets and operative notes was conducted for all patients with trimalleolar fractures who received surgical intervention. Among the 20 cases, 8 patients required posterior malleolar fixation in addition to medial and lateral malleolus osteosynthesis. In contrast, the remaining 12 patients with trimalleolar fractures with small posterior malleolar fragments (Figure 1), had their posterior malleolar fractures managed without any fixation devices (Figure 2).

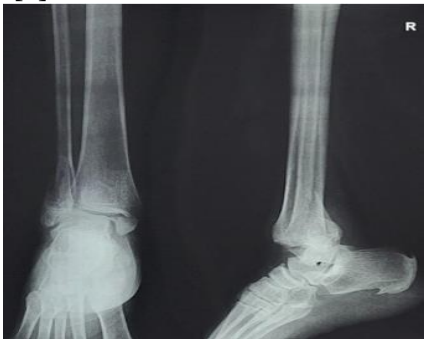

Figure 1. Pre-op X-Ray of Trimalleolar Fracture

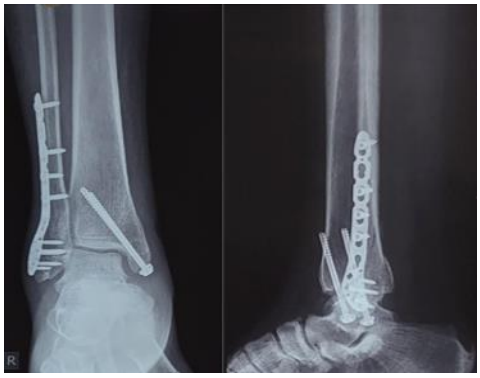

Figure 2. 3 Months Post-op Healed X-Ray of Trimalleolar Fracture where Posterior Malleolar Fractures Healed Well Without Any Fixation Devices

Inclusion and Exclusion Criteria

The patients included in the study are aged 18-70 years, with/without comorbidities, with or without ankle dislocation /subluxation. Those with an open wound or associated with multiple fractures in the same or opposite limbs are excluded from the study.

Operative Techniques

The choice of fixation method (screws, plates) was based on the pattern of injury and the treating consultant's preference.

Lateral malleolus - Lateral compression plate, buttress plate, 1/3rd fibular plate.

Medial malleolus - Canulated Cancellous screws/ Tension band wiring.

Posterior malleolus - Canulated Cancellous screws/ Locking compression plate.

Preoperative protocol: A well-structured preoperative protocol was followed which was essential for ensuring standardization in this study involving trimalleolar fractures. Initial Assessment and Stabilization were done by taking a detailed history, including the mechanism of injury, and time of injury and performing a thorough physical examination focusing on the affected ankle and lower limbs including neurovascular assessment by checking for distal pulse, Active toe movements, capillary refill time, sensory and motor functions. Imaging was done using x-rays in Anteroposterior view, lateral and mortise view to confirm the diagnosis and to know the extent of the fracture. Immobilization was done using a below-knee slab and required IV Analgesics. CT scan of the ankle joint was taken to check the involvement of the posterior malleolus (Figure 3). Routine blood investigations were sent. Medical clearance was obtained. Required written surgical consent was taken before the surgery.

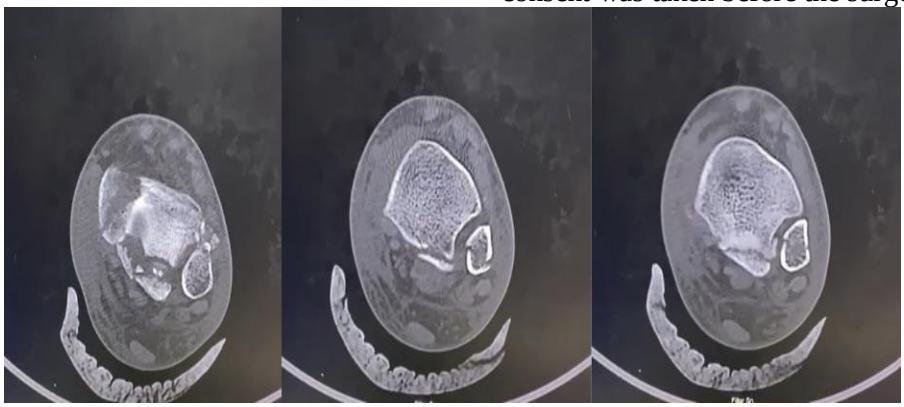

Figure 3. CT scan of the Ankle Joint was taken to Assess the Size of the Posterior Malleolar Fragment and Plan for Surgical Stabilization

Timing of Surgery: 16 patients were operated on at the earliest (0-12 hours) since the time of injury. Only 4 out of the 20 patients were operated on with a delay of two weeks, as these patients had poor skin conditions and severe swelling which was managed with a plaster slab and were operated on after the swelling had subsided.

Outcome Measures: Radiological outcomes were evaluated through serial imaging (at 6 weeks, 12 weeks, 6 months and 12 months) to monitor fracture healing, alignment, and integrity of fixation.

Follow-Up: Patients were followed up at 6 weeks, 12 weeks, 6 months and 12 months postoperatively along with a thorough evaluation of the scoring system (AOFAS) ankle and hindfoot score [6].

Post-op protocol: Below knee Plaster of Paris slab with ankle in a neutral position for 6 -8 weeks. Strict non-weight bearing walking for 6 weeks. Check x-ray at 6 weeks post-op followed by partial weight bearing to full weight bearing during 6 -12 weeks post-op.

Results

20 cases of trimalleolar fractures treated by operative intervention in our institute, between September 2021 to 2023 were studied retrospectively. All the patient's follow-up details were available. The Mean follow-up of 20 patients was 12 months with a minimum of 3 months and a maximum of 24 months. Out of 20 patients, 12 were males and 8 were females (Table 1). The average age was 46 years in the overall range of 18 to 70 years.

Table 1. Demographic Data

Age	Males	Females	Total cases	Percentage
18-50	4	2	6	30%
50-70	8	6	14	70 %
Total	12	8	20	100%

Only 3 (15%) out of the 20 patients had twisting injury and fall as a cause of fracture, whereas 17 (85%) patients had RTA (Road Traffic Accident) as the history. 16 out of the 20 patients had the operation for trimalleolar fracture within 1-2 days of injury. 4 patients had a delay in surgery of more than a week due to multiple reasons like poor skin condition, and medical comorbidities. The surgery was performed on an average of 2.3 days from the time of injury. Posterior Malleolus Fixation was done in 8 (40%) patients along with bimalleolar fixation, out of which only 3 cases had plate osteosynthesis for larger posterior malleolar fragments and unstable ankles (Figure 4). Remaining 5 cases, a CC (Cannulated Cancellous) screw was used to secure the posterior fragment (Figure 5). 12(60%) trimalleolar fracture cases had fixation of medial and lateral malleolus alone leaving the small posterior malleolar fragment to heal itself as the ankle joint was stable (Table 2).

Table 2. Fracture Stabilisation

Fracture	No. of cases fixed	Percentage
Medial malleolus	20	100%
lateral malleolus	20	100%
	Plate- 3	15%

Posterior malleolus	Screw-5	25%

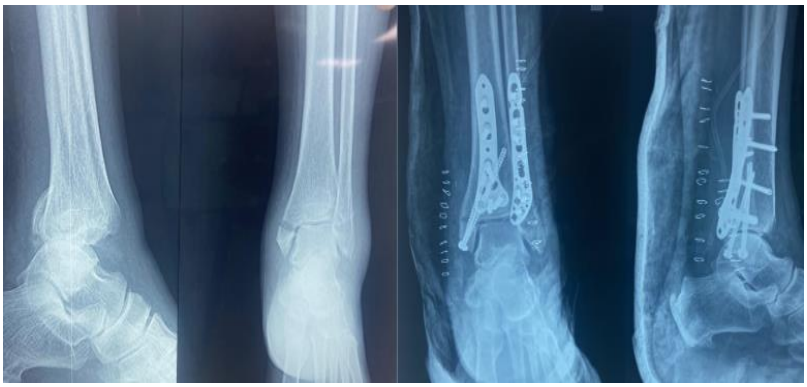

Figure 4. Preop and Postop X-Ray of a Case of Trimalleolar Fracture in which Posterior Malleolus is Stabilised with Plate and Screws

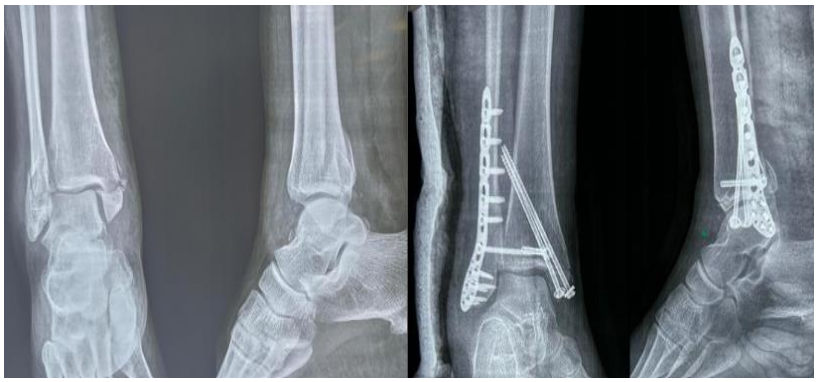

Figure 5. Preop and Postop X-Ray of a Case of Trimalleolar Fracture in which Posterior Malleolus is Stabilised with CC Screw

The fixation for the lateral malleolus was with plate and screws (locking, recon or 1/3rd tubular plate), whereas the medial malleolus was fixed with malleolar screws with washer or TBW (tension band wiring) and posterior malleolus with locking plate or cancellous screws. The average time taken for the fractures to heal was 8 weeks from the day of surgery. One patient had a superficial wound infection which healed within 3 weeks post-op. Only one patient had complications of wound dehiscence and malunion along with hardware irritation, which required implant removal and ankle arthrodesis.

Many patients (60%) experienced excellent functional outcomes. This indicates that the treatment or intervention was highly effective for most of the patients. A significant portion of patients (25%) had good outcomes. While not as optimal as excellent, these patients still benefited considerably from the treatment. A smaller group (10%) had fair outcomes. This suggests that the treatment was somewhat effective, but these patients may have had some limitations or residual issues. A very small percentage (5%) experienced poor outcomes, indicating that the treatment was not effective for these patients. This could be due to various factors such as the severity of their condition, comorbidities, or individual differences in response to treatment. The overall mean post-operative AOFAS score was 87. Also, significant improvement in the ankle range of movements from 6-12 weeks postop was noted. The majority of patients (75%) can return to work for a full day. This suggests that most

individuals have recovered sufficiently to resume their regular work schedules without restrictions. A significant group (70%) is very satisfied with their experience. This high percentage indicates a strong positive response and suggests that the treatment provided meets patient expectations (Table 3).

Table 3. Trimalleolar Fracture Fixation Results

Parameters	**Results**
Number of Patients	20
Age Range (Years)	18-70
Mean Age (Years)	46
Gender Distribution	12 Males (60%),8 Females (40%)
Cause of fracture	RTA (Road Traffic Accident) (85%), Twisting injury and fall (15%)
Timing of Surgery	
A. 0-12 hours after trauma	16 patients
B. Delayed after a week	4 patients
Need for Posterior malleolar fixation	8(40%)
Follow-up Duration (Minimum-Maximum)	3-24 months
Mean follow up	12 months
Fracture healing time (weeks)	6-14 weeks
Mean healing time (weeks)	8 weeks
Complications	
A. Infection	1(5%)
B. Nonunion	0%
C. Malunion	1(5%)
D. Hardware irritation	1(5%)
E. Ankle arthritis at 12 months	0%
Functional Outcomes	
A. Excellent	12(60%)
B. Good	5(25%)
C. Fair	2(10%)
D. Poor	1(5%)
Outcome scores (AOFAS)	
A. Mean Preoperative score	40
B. Mean Post-operative score	87
Range of motion (ROM)	
A. Dorsiflexion	15-20 degrees
B. Plantarflexion	30-40 degrees
Return to Work	
A. Full day	15(75%)
B. Modified duty	5(25%)
Unable to return	0
Patient Satisfaction	
A. Very satisfied	14(70%)
B. Satisfied	4(20%)

C. Neutral	1(5%)
D. Dissatisfied	1(5%)

Discussion

Managing trimalleolar fractures is particularly challenging due to the injury's complexity, requiring precise anatomical reduction and stable ankle joint to prevent long-term complications. This study examines the functional and radiological outcomes of patients treated with open reduction and internal fixation (ORIF) for trimalleolar fractures, offering valuable insights into the effectiveness of surgical intervention. Regaining the articular surface, maintaining the fibula's length, and stabilizing the lower tibiofibular end are all facilitated by posterior malleolus fixation which eventually allows for the early return of functional activity [7, 8].

Our retrospective study on 20 cases of trimalleolar fractures treated with surgical intervention had an average follow-up period of 12 months, with a minimum of 3 months and a maximum of 24 months. Among the 20 patients, 12 were male and 8 were female, with an average age of 46 years, which aligns with findings from previous research [9, 10]. A significant majority of the patients in our study, 17 (85%) out of 20, sustained trimalleolar fractures due to road traffic accidents (RTA). Similar studies in the literature reveal RTA as the main mode of injury [9]. Lauge Hansen's classification suggests supination external rotation as the commonest injury pattern. Studies have found that the majority of the patients had supination external rotation, followed by pronation abduction, and pronation external rotation, and the least had supination adduction as a mechanism of injury for these fractures [11]. Many researchers observed the same findings with minor differences [12, 13]. AO classification system suggests that Type B is the type commonly requiring surgical fixation [14].

The functional outcome in our study was assessed using a standard scoring system AOFAS for ankle fractures used by similar studies in the literature [15]. The majority of the patients showed significant improvements in pain, stability, and overall function. The average AOFAS score of 87/100 indicates a high level of functional recovery, enabling patients to resume daily activities and, in some cases, sports and occupational duties. The positive functional outcomes can be attributed to several factors. Firstly, accurate anatomical alignment of the fragments is important for restoring the congruity of the ankle joint. Intraoperative fluoroscopy was used to ensure precise reduction and fixation, which likely contributed to the excellent postoperative results. Secondly, the use of appropriate fixation techniques tailored to the individual fracture patterns, and the need for fixation of posterior malleolus when it involves a big chunk of articular surface affecting the ankle stability. Lastly, a comprehensive postoperative rehabilitation program focusing on a range of motion, strength, and proprioception exercises facilitated functional recovery.

Radiological outcomes in our study were satisfactory, with all patients showing progressive fracture healing and maintaining alignment at the 6-week, 3-month and 6-month follow-up. Radiographs confirmed that anatomical reduction was achieved and maintained, and there were no signs of hardware failure, non-union, or malalignment. The restoration of anatomical alignment is critical in preventing post-traumatic arthritis [16], which is a common complication of poorly managed trimalleolar fractures [17]. None of our cases in the study group had ankle arthritis at 12 months follow-up x-ray. Only one patient experienced complications, including wound dehiscence, malunion, and hardware irritation. This necessitated the removal of the implant and subsequent ankle arthrodesis which was performed at 6months follow-up.

Another study revealed a significant difference in wound complications between early and late surgeries, with rates of 3.6% and 12.9%, respectively ($p < 0.0001$) [18]. This finding is consistent with our study, where all patients who underwent surgery within a few days of trauma had no wound complications except for the one case with poor wound healing and malunion in which the surgery was delayed for more than 7 days due to medical comorbidities and poor skin condition at the time of presentation.

The postoperative protocol in our study was strict immobilization in below knee POP (Plaster of Paris) slab with the ankle in a neutral position for 6 - 8 weeks. All patients were put on Strict Non-weight-bearing walking for an initial 6 weeks. Then the check x-ray was taken at 6 weeks post-op after removing POP and healing of the fracture was assessed, followed by partial weight bearing to full weight bearing during 6 -12 weeks post-op. Initially, the ankle joint ROM (Range of Motion) was limited, but ankle movements improved rapidly following physiotherapy from 6 to 12 weeks. Studies have shown little varying post-op protocol with either no cast or just applied for a few days during the postoperative period and then allowed full joint mobilization out of the cast but strictly using crutches to maintain non-weight bearing status [19, 20]. While the AO advocates for early mobilization, even immobilization during the initial few post-op weeks has also proven to be beneficial. Other studies have found no significant difference in outcomes between early mobilization and immediate plaster splint.

Conclusion

Our retrospective study demonstrates that ORIF is an effective treatment for trimalleolar fractures, resulting in excellent functional and radiological outcomes. The choice of fixation method varied among patients, reflecting the need for individualized treatment plans based on the specific fracture characteristics. In this series, locking plating, cannulated screws, tension band wiring, and recon plates were used, based on the site of injury and type of fracture. The successful outcomes across different fixation methods underscore the importance of tailoring the surgical approach to the individual patient's anatomy and fracture pattern. The fixation of the posterior malleolus, in particular, significantly contributes to ankle stability and warrants discussion. 40% of our cases need fixation of posterior malleolus fragment and was anatomically reduced and secured with CC screw or plate and screws. The successful restoration of ankle function and alignment highlights the importance of precise surgical technique, early surgical stabilization, tailored fixation methods, and comprehensive postoperative rehabilitation. The insights gained from this study contribute to the growing evidence of using ORIF in the management of complex ankle fractures, emphasizing the critical role of individualized treatment plans and multidisciplinary care in achieving optimal outcomes.

Conflict of Interest

The authors declare no conflict of interest.

Acknowledgements

Yogeshwar A contributed towards analyzing the old case records, collecting relevant data needed for the study and following up details from the patient's records. Ganesh M T contributed to preparing the case study; editing, drafting the case series and collecting follow up data from the patient.

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