

Functional Outcome of Operated Ankle Fractures in Adults of Western Indian Population

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Abstract

Background: Ankle fractures are among the most common lower limb injuries encountered in orthopaedic practice, frequently resulting from road traffic accidents, falls, and sports-related trauma. Although surgical fixation aims to restore joint congruity and function, the final outcome is influenced by factors such as fracture pattern, timing of surgery, fixation stability, and postoperative rehabilitation.

Objective: To evaluate functional outcomes following surgical management of ankle fractures in adults from a Western Indian population and to identify factors influencing recovery.

Methods: This prospective observational study was conducted between February 2024 and December 2025, including 82 adult patients with closed ankle fractures treated with open reduction and internal fixation (ORIF). Functional outcomes were assessed at 6 months using the Olerud–Molander Ankle Score (OMAS). Statistical analysis was performed using SPSS version 25, with $p < 0.05$ considered statistically significant.

Results: The study population had a mean age of 42.6 ± 13.2 years with a male predominance (67%). Bimalleolar fractures were the most common (54%), followed by trimalleolar fractures (28%). The mean OMAS score at 6 months was 78.4 ± 12.6 . Overall, 71.9% of patients achieved excellent to good functional outcomes, while 9.7% had poor outcomes. Early mobilization was significantly associated with better functional recovery ($p < 0.01$).

Conclusion: Operative management of ankle fractures using ORIF yields satisfactory functional outcomes in the majority of patients. Early postoperative mobilization and adherence to structured rehabilitation protocols play a crucial role in optimizing recovery.

Keywords: Ankle fracture, ORIF, functional outcome, OMAS, rehabilitation, Western India.

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Introduction

Ankle fractures represent a significant proportion of musculoskeletal injuries presenting to emergency departments worldwide, with a rising incidence due to road traffic accidents and sports-related trauma [1,2]. These injuries range from simple unimalleolar fractures to complex trimalleolar fractures involving articular surfaces and syndesmotic disruption.

The primary goal of treatment is to achieve anatomical reduction, restore joint congruity, and allow early mobilization. Open reduction and internal fixation (ORIF) is considered the gold standard for displaced ankle fractures, providing superior anatomical alignment and improved functional outcomes compared to conservative management [3,4].

Functional recovery following ankle fractures is influenced by several factors including fracture type, patient age, and timing of surgery, fixation stability, and adherence to rehabilitation protocols [4]. The Olerud–Molander Ankle Score (OMAS) is a widely accepted and validated tool for evaluating functional outcomes in ankle fracture patients [5].

Recent literature has emphasized the importance of early mobilization and weight-bearing in enhancing recovery and improving long-term outcomes [6,7]. However, regional data from Western India remains limited, necessitating population-specific evaluation.

Materials and Methods

This prospective observational study was conducted at a tertiary care hospital in Western India from February 2024 to December 2025, including 82 adult patients with closed ankle fractures treated with ORIF.

Patients aged above 18 years with closed ankle fractures were included, while those with open fractures (Gustilo–Anderson Grade III), pathological fractures, and polytrauma were excluded. Surgical fixation was performed using plates and screws according to standard orthopaedic principles for ankle fracture management [3].

Postoperative care included a structured rehabilitation protocol with early initiation of range-of-motion exercises followed by progressive weight-bearing. Early mobilization has been shown to significantly improve functional outcomes and reduce complications such as joint stiffness and muscle atrophy [6,7]. Functional outcomes were assessed at 6 months using the Olerud–Molander Ankle Score (OMAS), a validated scoring system commonly used in clinical studies [5]. Statistical analysis was performed using SPSS version 25, with a p-value <0.05 considered statistically significant.

Inclusion Criteria

- Adult patients aged ≥ 18 years
- Patients with closed ankle fractures (including unimalleolar, bimalleolar, and trimalleolar fractures)
- Patients undergoing operative management with open reduction and internal fixation (ORIF)
- Patients willing to provide informed consent and comply with follow-up protocol
- Patients available for minimum 6-month follow-up

Exclusion Criteria

- Patients with open ankle fractures (Gustilo–Anderson Grade III)
- Undisplaced fractures managed conservatively
- Patients with polytrauma or associated major injuries affecting rehabilitation
- Pathological fractures
- Patients medically unfit for surgery
- Patients unwilling to participate or lost to follow-up

Statistical Analysis: All collected data were systematically recorded and analyzed using descriptive statistical methods. Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as frequencies and percentages. Functional outcomes were categorized based on the Olerud–Molander Ankle Score (OMAS), and results were interpreted accordingly. Data analysis was performed to identify patterns in fracture type, mechanism of injury, and clinical outcomes.

Ethical Approval: The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Prior approval was obtained from the Institutional Ethics Committee before the commencement of the study. Written informed consent was obtained from all participants after explaining the nature and purpose of the study. Patient confidentiality and data privacy were strictly maintained throughout the study period.

Results

A total of 82 patients with ankle fractures were included in the study. The demographic profile, injury characteristics, and treatment-related variables are summarized in Table 1.

The mean age of the study population was 42.6 ± 13.2 years, with the majority of patients belonging to the 30–50 years age group (49%), followed by those aged >50 years (29%) and <30 years (22%). There was a male predominance (67%), with a male-to-female ratio of approximately 2.1:1.

Regarding the mode of injury, road traffic accidents were the most common cause (56%), followed by falls (34%) and sports-related injuries (10%). In terms of fracture pattern, bimalleolar fractures were the most frequent (54%), followed by trimalleolar fractures (28%), while other fracture types accounted for 18% of cases.

Most patients (71%) underwent surgery within 5 days of injury, while 29% had delayed surgery. Early postoperative mobilization was initiated in 73% of patients, whereas 27% had delayed mobilization.

Table 1: Clinical Profile and Injury Characteristics of Patients Undergoing ORIF for Ankle Fractures

Variable	Category	Frequency (n)	Percentage (%)
Age Group (years)	<30	18	22%
	30-50	40	49%
	>50	24	29%
	Mean \pm SD	—	42.6 \pm 13.2
Gender	Male	55	67%
	Female	27	33%
Mode of Injury	Road Traffic Accident	46	56%
	Fall	28	34%
	Sports Injury	8	10%
Fracture Type	Bimalleolar	44	54%
	Trimalleolar	23	28%
	Others	15	18%
Time to Surgery	\leq 5 days	58	71%
	>5 days		
Mobilization	Early	660	73%
	Delayed	22	27%

Functional outcomes at 6 months were assessed using the Olerud–Molander Ankle Score (OMAS), and the results are presented in Table 2.

The mean OMAS score was 78.4 \pm 12.6, indicating overall satisfactory functional recovery. A majority of patients (71.9%) achieved excellent to good outcomes, with 38% classified as excellent and 34% as good. Fair outcomes were observed in 18% of patients, while 10% had poor outcomes. When analyzed across variables, younger patients (<50 years) demonstrated better functional outcomes compared to older patients. Similarly, patients with

bimalleolar fractures had higher mean OMAS scores compared to those with trimalleolar fractures. A statistically significant association was observed between early mobilization and improved functional outcomes, with patients undergoing early rehabilitation showing higher mean OMAS scores (84.3 \pm 9.8) compared to those with delayed mobilization (66.7 \pm 14.2, $p < 0.01$).

Additionally, patients who underwent early surgery (\leq 5 days) had better functional scores (81.6 \pm 10.7) compared to those with delayed surgery (70.2 \pm 13.9).

Table 2: Functional Outcome and Associated Factors (OMAS at 6 Months)

Variable	Category	Frequency (n)	Percentage (%)	Mean OMAS Score (\pm SD)
Overall Outcome	Excellent	31	38%	
	Good	28	34%	
	Fair	15	18%	
	Poor	8	10%	
	Mean OMAS	—	—	78.4 \pm 12.6
Age Group	<50 years	—	—	82.1 \pm 10.4
	\geq 50 years	—	—	71.3 \pm 13.8
Fracture Type	Bimalleolar	—	—	80.2 \pm 11.2
	Trimalleolar	—	—	72.5 \pm 13.5
Mobilization	Early	60	73%	84.3 \pm 9.8
	Delayed	22	27%	66.7 \pm 14.2
				$p < 0.01$
Timing of Surgery	\leq 5 days	58	71%	81.6 \pm 10.7
	>5 days	24	29%	70.2 \pm 13.9

Discussion

The present study demonstrates that operative management of ankle fractures using ORIF results in favorable functional outcomes, with 71.9% of patients achieving excellent to good results. These findings are consistent with previous studies and systematic reviews that support ORIF as the standard treatment modality for displaced ankle

fractures [5,6]. The mean OMAS score of 78.4 \pm 12.6 observed in this study is comparable to earlier reports, reinforcing the effectiveness of surgical fixation in restoring ankle function [2,6]. The predominance of male patients is consistent with epidemiological trends, where males are more frequently exposed to high-energy trauma such as road traffic accidents [1,3].

Fracture pattern significantly influenced functional outcomes, with bimalleolar fractures showing better recovery compared to trimalleolar fractures. Increased fracture complexity is associated with greater articular involvement and instability, leading to relatively poorer outcomes [6]. A key finding of this study is the significant association between early mobilization and improved functional outcomes ($p < 0.01$). Patients who underwent early physiotherapy demonstrated higher OMAS scores, which is supported by recent systematic reviews and clinical studies emphasizing the benefits of early weight-bearing and rehabilitation [7,8].

Delayed surgical intervention was associated with poorer outcomes, likely due to soft tissue complications and difficulty in achieving anatomical reduction. Early intervention facilitates better alignment and reduces postoperative complications [5]. Age was also found to influence recovery, with younger patients demonstrating better outcomes compared to older individuals. This observation is consistent with recent studies highlighting the impact of age and comorbidities on functional recovery following ankle fractures [9].

Furthermore, long-term studies have demonstrated that although most patients achieve good short-term outcomes, a subset may develop persistent symptoms or post-traumatic arthritis, highlighting the importance of optimal early management [10].

Limitations: The present study has several limitations that should be acknowledged. The relatively small sample size ($n = 82$) may limit the statistical power of the findings. Additionally, the single-center design may restrict the generalizability of the results to a wider population with varying demographic and healthcare settings.

The follow-up period of 6 months is relatively short and does not allow for assessment of long-term outcomes such as post-traumatic osteoarthritis, chronic ankle instability, or implant-related complications. Furthermore, the absence of a control or comparison group limits the ability to directly compare different treatment strategies.

Future Recommendations: Future research should focus on larger, multicentric studies to improve the external validity and generalizability of the findings. Long-term follow-up is essential to evaluate late complications, including degenerative joint changes and functional deterioration over time.

Comparative studies assessing operative versus conservative management, as well as different surgical techniques and rehabilitation protocols, would provide deeper insights into optimizing treatment strategies. Incorporating patient-reported outcome measures (PROMs) and quality-of-life

assessments may further enhance the clinical relevance of future studies.

Conclusion

Anatomical reduction and stable internal fixation remain the cornerstone in the management of displaced ankle fractures. Open reduction and internal fixation (ORIF) continues to be the treatment of choice, providing satisfactory functional outcomes in the majority of patients. Early postoperative mobilization plays a pivotal role in enhancing rehabilitation and improving overall functional recovery. Additionally, a thorough understanding of the mechanism of injury and fracture pattern is essential for appropriate planning and achieving optimal clinical outcomes.

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