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Functional outcome of surgical management of Bimalleolar ankle fractures

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ABSTRACT

Background: Bimalleolar fractures of the ankle are complex injuries that involve both bone and ligamentous structures, affecting joint stability and function. This prospective study examines the functional outcomes of surgical management for bimalleolar fractures treated at a tertiary care center. **Aims and Objectives:** This study aims to evaluate the functional outcomes of surgical management in patients with bimalleolar ankle fractures, with a focus on post-surgical complications, recovery rates, and factors influencing prognosis. The primary objectives include assessing post-operative range of motion, the incidence of complications, and overall functional outcomes based on established scoring systems. **Materials and Methods:** Thirty patients, aged 6–60 years with closed bimalleolar fractures, underwent surgical fixation using various techniques, including malleolar screws, K-wires, and plate fixation. Functional outcomes were assessed over 24 months using clinical evaluations, radiographic analysis, and patient-reported scoring systems. **Results:** The results showed that 80% of patients achieved good to excellent outcomes, with minimal complications. Complications, such as infection and non-union, were observed in 40% of cases. **Conclusion:** The findings suggest that surgical management of bimalleolar fractures using internal fixation techniques leads to favorable outcomes, restoring ankle stability and function in most patients. Early intervention, accurate anatomical reduction, and appropriate rehabilitation are essential to optimizing recovery and minimizing complications.

Key words: Bimalleolar ankle fracture; Open reduction internal fixation; Surgical outcome; Functional recovery

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INTRODUCTION

The ankle joint is a hinged synovial joint, critical for body movement and weight-bearing functions. It involves the interlocking mortise formed by the distal tibia and fibula with the talus, supported by ligaments such as the inferior tibiofibular syndesmosis and deltoid ligaments.[1] Bimalleolar fractures, involving both the medial and lateral malleoli, are complex injuries that compromise the ankle's structural integrity, leading to instability and potential long-term disability if not treated appropriately.[2]

Ankle fractures account for a significant proportion of musculoskeletal injuries, and bimalleolar fractures represent one of the more severe forms due to the involvement of both bone and soft tissue structures.[3] These fractures usually result from high-energy trauma, such as road traffic accidents (RTAs) or falls, and are commonly classified using systems such as the Lauge–Hansen and Danis–Weber classifications.[4,5] Understanding the mechanism of injury and the anatomical components involved is essential to achieving successful treatment outcomes. The complexity of ankle fractures, especially bimalleolar fractures, often requires surgical management to achieve optimal functional outcomes.[6]

The primary goal in managing bimalleolar fractures is achieving anatomical reduction, restoring joint stability, and

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enabling early mobilization to prevent complications such as post-traumatic arthritis and limited joint mobility.[7] Surgical interventions, particularly open reduction and internal fixation (ORIF), have become the standard treatment for unstable or displaced fractures, yielding superior outcomes compared to non-operative management.[8] Techniques such as malleolar screw fixation, tension band wiring (TBW), and plating are widely used to restore ankle biomechanics and facilitate early weight-bearing.[9]

However, bimalleolar fractures remain challenging due to the potential for complications, including infection, non-union, and malunion.[10] The success of surgical management depends on factors such as the timing of surgery, the fixation method used, and post-operative rehabilitation. Achieving a successful return to activity is a key factor in assessing recovery, as noted in systematic reviews on post-operative outcomes.[11] This study aims to evaluate the functional outcomes of surgically managed bimalleolar fractures and assess complications associated with different fixation techniques.

Aims and objectives

To study functional outcome of surgical management of Bimalleolar ankle fractures.

1. To determine functional outcome of surgical management of Bimalleolar ankle fractures
2. To assess complications associated with different fixation techniques

MATERIALS AND METHODS

This was a prospective study conducted at a tertiary care center over 24 months. The study included 30 patients diagnosed with bimalleolar fractures of the ankle who were treated surgically. The ethical committee clearance was obtained before the beginning of the study.

Inclusion criteria

- Patients with closed bimalleolar fractures, with or without ankle dislocation, were included.

Exclusion criteria

- Patients with isolated lateral or medial malleolar fractures, and those with comorbidities preventing surgery, were excluded.

Data collection procedure

Upon admission, patients underwent a thorough clinical examination, including a detailed history and limb assessment. The patient's detailed history was taken in the view of etiology, co-morbidities, and an examination of both normal as well as affected or fractured limbs was carried out. Measurements of the limbs were taken as a length in centimeters and range of movements in degrees. Radiographic investigations, such as X-rays, were performed to assess fracture severity and plan surgical intervention. Surgical procedures, including ORIF, were conducted using techniques such as malleolar screws, K-wires, and plate fixation.[12]

Patients were followed for up to 4 months with weekly evaluations to assess recovery, range of motion, and complications. Radiographs were taken at each follow-up to monitor fracture healing. Outcomes were assessed using a subjective score (pain, deformity, and range of motion) and an objective score (clinical and radiological evaluation).[13] Complications, including infection, non-union, and arthritis, were also recorded.

Statistical analysis

Data were analyzed using descriptive statistics, such as means, standard deviations, and percentages. Associations between parameters were analyzed using the Chi-square test, with a $P<0.05$ considered statistically significant.

RESULTS

The study included 30 patients, with a mean age of 39.86±10.67 years. Most patients belong to the age group 40–49 (37%) and (80%) were male (Table 1).

Most patients 63.3% had right-sided fractures. The primary injury mechanism was RTAs in 60% of cases, followed by self-fall twisting injuries (30%) and falls from height (10%) (Table 2).

According to the Lauge–-Hansen classification, the most common injury type was supination-external rotation,

Table 1: Basic characteristics

Characteristics	Number	Percentage
Age		
<30	7	23
30–39	5	17
40–49	11	37
50–59	7	23
Gender		
Male	24	80
Female	06	20

Table 2: Distribution of injury-related

Parameters	Number	Percentage
Side injured		
Left	11	36.7
Right	19	63.3
Mode of injury		
Fall from height	3	10
RTA	18	60
Self-fall and twisting	9	30

RTA: Road traffic accidents

Table 3: Distribution of fracture classification

Parameters	Number	Percentage
L-H classification		
PAB	2	6.7
PER	7	23.3
SAD	3	10.0
SER	18	60.0
AO classification		
A	3	10.0
B	18	60.0
C	9	30.0

SAD: Supination-adduction, PAB: Pronation abduction, PER: Pronation-external rotation, SER: Supination-external rotation

observed in 60% of cases, followed by pronation-external rotation and supination-adduction. Using the Danis–Weber classification, 60% were Type B, 30% were Type C, and 10% were Type A (Table 3).

The most commonly used surgical method was malleolar screw fixation combined with fibular plate and screws, used in 46.7% of patients. Other methods included K-wires, TBW, and conservative treatment for select cases. The average time between injury and surgery was 5.63±3.86 days.

Superficial infections were the most common complication, occurring in 16.7% of cases. Other complications included deep infections (3.3%), non-union (3.3%), and malunion (3.3%). One patient developed non-union arthritis and required revision surgery (Table 4).

In Table 5, outcomes were assessed using a subjective score (pain, deformity, and range of motion) and an objective score (clinical and radiological evaluation).

At the final follow-up, 80% of patients achieved good to excellent functional outcomes, as measured by subjective and objective scoring systems. Key findings:

- Pain Scores: 50% of patients reported mild pain (score 1), and 30% reported no pain (score 0)
- Deformity Scores: 60% of patients had a score of 1, indicating mild residual deformity
- Range of Motion: 93.3% had a normal range of motion, whereas 6.7% had mild limitations
- Radiological Outcomes: Radiographs showed excellent alignment in 63.3% of cases (score 0), with 30% showing minor alignment issues (score 1).

DISCUSSION

This study demonstrates that surgical management of bimalleolar fractures using internal fixation techniques leads to favorable functional outcomes in most cases. Anatomical reduction and restoration of the ankle mortise were achieved in the majority of patients, allowing for early mobilization and rehabilitation, which are essential for successful recovery.

Table 4: Distribution of surgical intervention and complications

Parameters	Number	Percentage
Surgical intervention		
MM-K-wires and fibula-plate and screws	5	16.6
MM-Malleolar screw, fibula-plate and screws, and syndesmotic screw	2	6.7
MM-Malleolar screw and fibula-conservative	2	6.6
MM-Malleolar screw and fibula-K-wires	1	3.3
MM-Malleolar screw and fibula-plate and screws	14	46.7
MM-Malleolar screw, fibula-plate and screws, and PM-Malleolar screw	1	3.3
MM-Malleolar screw and fibula-k wire intramedullary	1	3.3
MM-TBW, fibula-plate, and screws	4	13.3
Complications		
Deep infection	1	3.3
Deep infection and talar shift	1	3.3
Lateral Talar tilt	1	3.3
Non-union and arthritis	1	3.3
Non-union of MM and revision done	1	3.3
Superficial infection	5	16.7
Superficial infection and malunion	1	3.3
Talar tilt and shift	1	3.3
Nil	18	60.0

TBW: Tension band wiring

Table 5: Functional outcome

Outcome	Number	Percentage
Subjective		
Excellent	12	40.0
Fair	4	13.3
Good	12	40.0
Poor	2	6.7
Pain		
0	9	30.0
1	15	50.0
2	5	16.7
3	1	3.3
Deformity		
0	3	10.0
1	18	60.0
2	8	26.7
3	1	3.3
Range of motion		
0	28	93.3
2	2	6.7
Objective		
Fair	6	20.0
Good	22	73.3
Poor	2	6.7
Radiological		
0	19	63.3
1	9	30.0
2	2	6.7

Gender distribution

In our study, 80% of the patients were male, whereas 20% were female. This is consistent with other reports that found a male predominance in ankle fractures. Studies by Shah and Arif, (60% male and 40% female)[14] and Jhatoth et al., (77.7% male and 22.3% female)[15] support our findings, attributing this difference to the higher participation of males in outdoor activities, leading to increased exposure to trauma. However, some studies, such as that by Beris et al., (38% male and 62% female), report a higher incidence of ankle fractures in females, potentially reflecting differences in the patient population or geographic factors.[16]

Age distribution

The mean age of the patients in our study was 40.5 years for males and 37.1 years for females. This aligns with previous research. Roberts SR reported a mean age of 40 years, whereas studies by Beris et al. and Shah and Arif, reported mean ages of 30 and 37.4 years, respectively.[14,16] These findings are indicative of ankle fractures being common in middle-aged individuals, likely due to active lifestyles combined with age-related reductions in bone density and balance.

Injury related

Our results showed that 62% of the fractures occurred on the left side and 38% on the right, contrasting with studies such as Shah and Arif, which found right-side predominance (62.5%).[14] The reasons for side dominance are unclear, but this variability could be linked to individual biomechanics or the nature of trauma.

RTAs were the predominant cause of injury (60%), followed by self-fall (30%) and falls from height (10%). This correlates with studies by Dharmesh Patel et al., where RTA was the leading cause in 63.3% of cases. RTAs typically result in more severe injuries requiring surgical intervention, which might explain the higher prevalence in our study population.[17]

Fracture classification

According to AO classification, 60% of the cases in our study were Type B fractures, consistent with findings by Hughes et al., (64.8%). Type B fractures typically involve a rotational mechanism, which is commonly seen in high-impact injuries such as RTAs, which were the most common mode of injury in this study.[18]

Injury to surgery interval

Most of our patients (53.3%) underwent surgery within 5 days of injury, with 36.7% operated on within 6–10 days. Studies suggest that early surgical intervention, particularly within the 1st week, is crucial for optimal outcomes. Delay in surgery has been associated with complications such as infection and delayed union, although these were minimized in our cohort with timely intervention.

Type of fixation

The most common method of fixation was the use of malleolar screws for the medial malleolus and plate and screws for the fibula (56.7%). This technique provides robust stability, allowing for early mobilization and good functional outcomes. Studies by Dharmesh Patel et al., also support the use of plate and screw fixation for the fibula and malleolar screws for the medial malleolus as the preferred method of treatment.[17]

Functional outcomes

The subjective scoring in our study revealed that 40% of patients had an excellent outcome, 40% had a good outcome, 13.3% had a fair outcome, and 6.7% had a poor outcome. These findings are in line with Shah and Arif, who reported excellent results in 57.5% of cases.[14] The high rate of good-to-excellent outcomes underscores the importance of accurate anatomical reduction, stable fixation, and early mobilization in achieving optimal functional recovery.

The objective scoring demonstrated that 73.3% of patients had a good outcome, 20% had a fair outcome, and 6.7% had a poor outcome. A study by Singh et al., reported similar results, with 76% achieving good and excellent outcomes.[19] The differences in outcomes could be attributed to variations in patient rehabilitation and adherence to post-operative protocols. Our results align with recent literature indicating that successful ankle fracture recovery significantly enhances quality of life and functionality.[20] Patient-reported outcomes are essential for evaluating functional recovery, and recent studies emphasize the impact of both patient and fracture characteristics on outcomes.[21]

Complications

In our study, complications were observed in 40% of the cases. The most common complications were superficial infections (20%), followed by deep infections (6.7%), non-union (6.7%), lateral shift (3.3%), and talar shift (3.3%). Shah and Arif also reported superficial infection in four patients and deep infection in one patient.[14] Although infection rates are a concern in open fractures, the use of appropriate prophylactic antibiotics and timely intervention helped mitigate serious complications in our study.

Despite complications, 80% of patients achieved favorable functional outcomes. These findings align with previous research demonstrating high success rates with ORIF for bimalleolar fractures.[17] Early rehabilitation and weight-bearing, made possible by stable fixation, are essential for optimal joint recovery and preventing long-term disability.

Limitations of the study

The main limitation of the study was small sample size. Further study can be done on larger sample size.

CONCLUSION

ORIF, particularly using malleolar screws and fibular plating, provides stable fixation that enables early mobilization and rehabilitation, leading to improved joint function with minimal long-term complications. The findings of this study support surgical intervention as the standard of care for unstable bimalleolar fractures, with a focus on achieving accurate anatomical reduction and initiating early post-operative rehabilitation.

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REFERENCES

1. Solomon L, Warwick D, Nayagam S and Apley A. Apley's System of Orthopedics and Fractures. 9th ed. London: Hodder Arnold; 2010.
2. James D, Heckman C, Court-Brown P, Tornetta P, Koval K and Bucholz R. Rockwood and Greens' Fracture in Adults. 6th ed., Vol. 2. Philadelphia, PA: Lippincott Williams and Wilkins; 2010.
3. Ashurst AP and Bromer RS. Classification and mechanism of fractures of the leg bones involving the ankle joint. Arch Surg. 1922;4:51.
4. Lauge-Hansen N. "Ligamentous" ankle fractures: Diagnosis and treatment. Acta Chir Scand. 1949;97(6):544-550.
5. Danis R. Malleolar fractures. In: Danis R, editor. Theory and Practice of Osteosynthesis. Paris: Masson; 1949. p. 133-165.
6. Lorente A, Pelaz L, Palacios P, Benlloch M, De la Rubia Ortí JE, Barrios C, et al. Predictive factors of functional outcomes and quality of life in patients with ankle fractures: A systematic review. J Clin Med. 2024;13(5):1188.
https://doi.org/10.3390/jcm13051188
7. Weber B and Colton C. Malleolar fractures. In: Müller M, Allgöwer M, Schneider R and Willenegger H, editors. Manual of Internal Fixation. 3rd ed. Berlin: Springer; 1991. p. 595-612.
8. Joy G, Patzakis M and Harvey JP. Precise evaluation of the reduction of severe ankle fractures. J Bone Joint Surg Am. 1974;56(5):979-993.
9. Leeds HC and Ehrlich MG. Instability of the distal tibiofibular syndesmosis after bimalleolar and trimalleolar ankle fractures. J Bone Joint Surg Am. 1984;66(4):490-503.
10. Lindsjö U. Classification of ankle fractures: the Lauge-Hansen or AO system?. Clin Orthop Relat Res. 1985;199:12-6.
11. Johns WL, Sowers CB, Walley KC, Ross D, Thordarson DB, Jackson JB, et al. Return to sports and activity after total ankle arthroplasty and arthrodesis: A systematic review. Foot Ankle Int. 2020;41(8):916-929.
https://doi.org/10.1177/1071100720927706
12. Buckley R. Tricortical screws were as effective as quadricortical screws in ankle fractures at 1 year. J Bone Joint Surg Am. 2005;87(2):465.
13. Gennis E, Koenig S, Rodericks D, Otlans P and Tornetta P. The fate of the fixed syndesmosis over time. Foot Ankle Int. 2015;36(10):1202-1208.
https://doi.org/10.1177/1071100715588186
14. Shah ZA and Arif U. Surgical management of bimalleolar fractures of ankle. Pak J Med Health Sci. 2013;7(2):471.
15. Jhatoth DS. Evaluation and surgical management of bimalleolar fractures of ankle joint. Int J Orthop Sci. 2017;3(3):620-623.
https://doi.org/10.22271/ortho.2017.v3.i3i.98
16. Beris AE, Kabbani KT, Xenakis TA, Mitsionis G, Soucacos PK and Soucacos PN. Surgical treatment of malleolar fractures. A review of 144 patients. Clin Orthop Relat Res. 1997;(341):90-98.
17. Dharmesh Patel B, Patel D, Singh A, Vohra R and Chauhan S. Radiographic and functional outcome of bimalleolar fractures treated by open reduction and internal fixation with screws/TBW and plates: A prospective study. Orthop Sport Med Open Access J. 2021;5(1):492-96.
18. Hughes JL, Weber H, Willenegger H and Kuner EH. Evaluation of ankle fractures: Non-operative and operative treatment. Clin Orthop Relat Res. 1979;(138):111-119.
19. Singh D, Bhardwaj D, Vaishy D and Vaish D. Functional outcome of close Bimalliolar fracture treated by open reduction and internal fixation by various methods: A retrospective study. Int J Orthop Sci. 2017;3(2d):431-435.
https://doi.org/10.22271/ortho.2017.v3.i2d.34
20. Nguyen MQ, Dalen I, Iversen MM, Harboe K and Paulsen A. Ankle fractures: A systematic review of patient-reported outcome measures and their measurement properties. Qual Life Res. 2023;32(1):27-45.
21. Chan BH, Snowdon DA and Williams CM. The association between person and fracture characteristics with patient reported outcome after ankle fractures in adults: A systematic review. Injury. 2022;53(6):2340-2365.
https://doi.org/10.1016/j.injury.2022.02.016

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SD- Definition of intellectual content, literature survey, prepared the first draft of the manuscript, implementation of the study protocol, data collection, data analysis, manuscript preparation, and submission of the article; **AD-** Concept, design, manuscript preparation, statistical analysis, and interpretation, editing, and manuscript revision; Design of study, statistical analysis, and interpretation.

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