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Original Research Article

Functional Outcome of Bimalleolar Ankle Fracture Treated with Open Reduction and Internal Fixation

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Abstract:

Background: Bimalleolar ankle fractures are common orthopaedic injuries that often require surgical intervention due to their unstable nature. These bimalleolar fractures significantly impair mobility and are associated with long-term complications such as chronic pain and arthritis if not treated properly. Open Reduction and Internal Fixation (ORIF) is the preferred surgical treatment for achieving anatomical reduction and functional recovery.

Objective: This study aims to evaluate the functional outcomes of bimalleolar fractures treated with ORIF, using the Baird-Jackson scoring system to assess pain, range of motion, and overall joint stability. The secondary objective is to assess complications arising post-surgery.

Results: Among 25 patients, the majority (68%) were male, with an average age of 41-60 years. Road traffic accidents were the most common cause (84%). Post-operative complications included 3 cases of ankle stiffness and 1 case of superficial infection. Functional outcomes were positive, with 8 patients achieving excellent results and 12 reporting good outcomes. The mean pre-operative VAS score was 7.56, which improved to 6.6 post-surgery.

Conclusions: ORIF is an effective treatment for bimalleolar fractures, providing favourable functional outcomes, reduced pain, and minimal complications. Proper anatomical reduction and surgical technique are essential for optimal recovery and preventing long-term complications such as joint instability and arthritis.

Keywords: Bimalleolar fracture; ORIF; Ankle Injury; Functional Outcome; Surgical Intervention; Complications; Fracture Union.

Introduction

Bimalleolar ankle fractures represent a significant subset of ankle injuries, often necessitating surgical intervention due to their complexity and potential to impair mobility if not managed appropriately. The ankle joint, formed by the articulation of the tibia, fibula, and talus bones, is crucial for maintaining stability and facilitating a wide range of movements such as walking, running, and balancing [1]. Any disruption to this joint, particularly in the form of fractures involving the medial and lateral malleoli, can lead to significant functional impairment. Bimalleolar fractures account for approximately 60% of all ankle fractures, making them a common yet critical concern in orthopaedic trauma care [2].

The incidence of bimalleolar fractures tends to follow a bimodal distribution, most frequently affecting older women and younger males, typically as a result of high-energy trauma such as road traffic accidents or sports injuries [3]. Additionally, the prevalence of these fractures increases with age due to factors like osteoporosis, which weakens the bones, rendering them more susceptible to injury. Prompt and accurate management of these fractures is vital for restoring function and preventing long-term complications such as chronic pain, instability, and post-traumatic osteoarthritis [4]. Understanding the nature of a bimalleolar ankle fracture requires a thorough knowledge of the different classification systems that are used to evaluate the severity and complexity of these injuries. The Danis-Weber classification system categorizes fractures based on the level of the fibular fracture relative to the syndesmosis—a fibrous joint connecting the tibia and fibula [5].

Type A fractures are infra-syndesmotic, Type B fractures are trans-syndesmotic, and Type C fractures occur above the syndesmosis. This classification is crucial for determining the stability of the fracture and guiding treatment [6]. In addition to the Danis-Weber system, the Lauge-Hansen classification is another widely recognized method that focuses on the mechanism of injury.

This system takes into account the position of the foot at the time of injury (such as supination or pronation) and the direction of the deforming force (e.g., abduction or external rotation). This approach not only helps in identifying the type of fracture but also assists in predicting associated ligamentous injuries, which are commonly seen in bimalleolar fractures [7].

While non-surgical management, including immobilization and casting, may be appropriate for stable, non-displaced fractures, the majority of bimalleolar fractures require surgical intervention due to their unstable nature [8]. Open Reduction and Internal Fixation (ORIF) has become the gold standard for treating unstable ankle fractures, particularly those involving both the medial and lateral malleoli. The primary goal of ORIF is to achieve anatomical reduction of the fracture, restoring the alignment of the ankle joint and preventing future complications such as malunion, non-union, or arthritis [9].

The importance of anatomical reduction cannot be overstated. Even a small displacement of the talus within the ankle mortise—such as a shift of just 1 mm—can lead to a significant decrease in the contact area between the talus and the tibia, resulting in increased pressure on the remaining joint surfaces [10]. This imbalance can accelerate the wear and tear of the cartilage, leading to early onset osteoarthritis. Studies have consistently demonstrated that patients who undergo ORIF for bimalleolar fractures have better functional outcomes, lower pain levels, and fewer complications compared to those managed conservatively [11].

The surgical approach to treating bimalleolar fractures typically involves fixation of both the lateral and medial malleoli. For the lateral malleolus, a plate and screw construct is often used to stabilize the fracture [12]. The choice of plate—such as a 1/3 tubular plate or a recon plate—depends on the location and type of fracture, and it is contoured to fit the lateral aspect of the fibula. In cases where the syndesmosis is disrupted, additional screws may be placed across the joint to stabilize the tibia and fibula, preventing further widening of the joint space [13].

The medial malleolus, which is typically fractured in a vertical or oblique pattern, is fixed using either lag screws or tension band wiring. The goal is to compress the fracture fragments together, restoring the congruency of the joint surface and ensuring that the talus remains properly aligned within the ankle mortise. Post-operatively, patients are usually immobilized in a plaster cast or a splint for six weeks, followed by gradual weight-bearing as tolerated [14].

Functional outcomes following ORIF of bimalleolar fractures are generally positive, with the majority of patients regaining full function within six months. The Baird-Jackson scoring system, which evaluates pain, function, and radiographic alignment, is often used to assess the success of the procedure. In most cases, patients report significant improvements in pain levels, range of motion, and overall mobility [15]. However, certain factors such as the patient's age, the energy level of the trauma, and the presence of comorbidities can influence the outcome. Older patients or those with pre-existing conditions like diabetes or peripheral vascular disease may have a slower recovery or a higher risk of complications [16].

Post-operative complications are relatively uncommon but can include infection, wound dehiscence, or delayed healing. Proper surgical technique and post-operative care are essential to minimizing these risks and ensuring a successful outcome. Long-term follow-up is also crucial, as some patients may develop post-traumatic arthritis despite successful surgical intervention [17].

The treatment of bimalleolar fractures through ORIF remains the standard of care for unstable injuries, offering excellent functional outcomes and a high rate of return to pre-injury activity levels. By restoring the anatomical alignment of the ankle joint, ORIF not only facilitates early mobilization but also prevents long-term complications, making it an indispensable tool in the management of these complex fractures [18].

The aim of this study is to evaluate the efficacy of Open Reduction and Internal Fixation (ORIF) as a surgical intervention for the management of bimalleolar ankle fractures.

The primary objective is to assess the functional outcomes of patients treated with ORIF, using the Baird-Jackson scoring system to measure pain levels, range of motion, and overall joint stability. Additionally, the study seeks to determine the time required for fracture union and to evaluate any complications that may arise during the recovery period, with a focus on achieving optimal anatomical and functional restoration of the ankle joint.

Methods

The present study, titled "Functional Outcome of Bimalleolar Ankle Fractures Treated with Open Reduction and Internal Fixation," was conducted in the Department of Orthopaedics at Kempegowda Institute of Medical Sciences, Bengaluru, from July 2022 to December 2024, following ethical committee approval.

This prospective study aimed to evaluate the outcomes of 25 patients with closed and open type

1, 2, and 3a bimalleolar fractures. Patients over 16 years were included, while those with compound type 3b fractures, intraarticular extensions, vascular injuries, or paralytic limbs were excluded. Data collection involved informed consent, clinical evaluations, and routine preoperative investigations

Results

We conducted this study at a tertiary care hospital after obtaining approval from the institutional ethics committee. A total of 25 patients with post-traumatic bimalleolar ankle fractures, meeting the selection criteria, were enrolled and managed with ORIF using plate and screws for the lateral malleolus and CC screws, malleolar screws, or tension band wiring for the medial malleolus.

The table outlines complications following three surgical procedures for bimalleolar fractures. Out of 25 patients, 18 had no complications. One patient experienced chronic infection, two had superficial skin infections, and four developed ankle stiffness. The highest complications occurred in the ORIF with malleolar screws, showing three cases of ankle stiffness. TBW showed minimal complications, while ORIF with CC screws reported no significant complications.(Table 1)

The table compares preoperative and postoperative Visual Analog Scale (VAS) scores for 25 patients. The mean preoperative VAS score was 7.56 (±0.65), while the mean postoperative score decreased to 6.6 (±0.65), indicating a reduction in pain following surgery. The standard error of the mean for both scores is 0.13.(Table 2)

The Baird and Jackson score outcomes for different surgical procedures in treating bimalleolar fractures. Among 25 patients, 8 had excellent results, 13 showed good outcomes, 4 had fair results, and none had poor outcomes. ORIF with malleolar screws demonstrated the highest number of good outcomes, while ORIF with CC screws had the most excellent results.(Figure 1) The table presents the Baird and Jackson scores with corresponding frequencies and mean values. Out of the total patients, 12 had good outcomes (mean score 93.5±0.67), 8 had excellent outcomes (97±0.53), 4 had fair outcomes (83.75±1.26), and 1 patient had a poor outcome with a score of 78.(Table 3)

The table displays the Dennis-Brown classification distribution for 25 patients. Out of the total, 44% (11 patients) were classified as Type A, while 56% (14 patients) fell under Type B. No invalid cases were reported, ensuring a complete classification for all participants in the study (Table 4)

The figure represents the mechanism of injury (MOI) for 25 patients. Road traffic accidents (RTA) were the predominant cause, accounting for 84% (21 patients), while 16% (4 patients) sustained injuries from slips and falls. This data highlights that RTAs are the leading cause of bimalleolar fractures in the study population (Figure 2)

The table shows the distribution of the side involved in bimalleolar fractures for 25 patients. The right side was more frequently affected, with 68% (17 patients), while the left side was involved in 32% (8 patients). There were no invalid cases, ensuring complete data for all patients in the study (Table 5)

The distribution of surgical procedures performed on 25 patients with bimalleolar fractures. The most common procedure was ORIF with malleolar screws and plates for the lateral malleolus, performed on 52% of patients (13). ORIF with TBW was performed on 36% (9), while ORIF with CC screws was performed on 3% (3) of the population (Figure 3)

Table 1: Complications Associated with Different Modalities of Management

Procedure	Complications			
	Nil	Chronicinf	SuperfcialskinInf	Ankestifness
Orif with malleolar screw to Medial malleolus orif plate And Screws to lateral Malleolus	6	1	1	3
Tbw medial malleolus orif Plate And Screws to lateral malleolus	8	0	1	1
Orif with cc screws to medial malleolus orif Plates and screws to lateral malleolus	4	0	0	0
Total	18	1	2	4

Table 2: VAS Score Comparison Before and After Surgery

	n	Mean	Std. Deviation	Std. Error Mean
Pre Op Vas Score	25	7.56	0.65	0.13
Post Op Vas Score	25	6.6	0.65	0.13

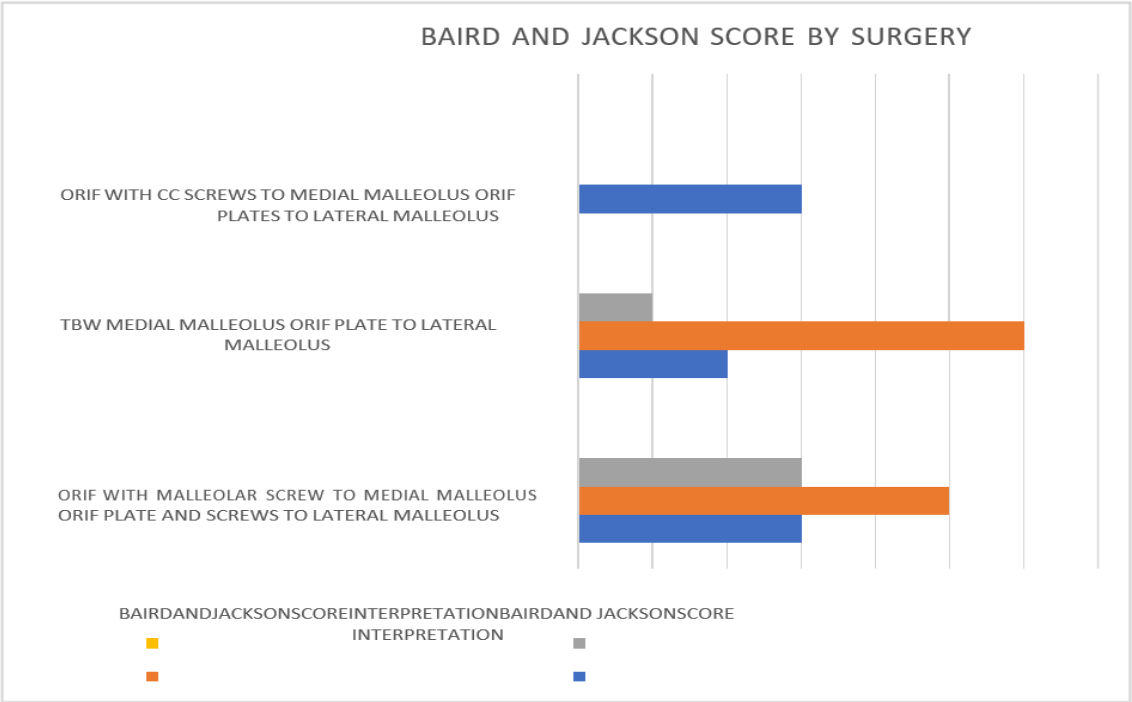

Figure 1: Baird-Jackson Score Distribution On The Basis Of Surgery Performed

Table 3: Baird-Jackson Scoring of Fractures amongst the Study Group

		Frequency	Mean±SD.
Baird and Jackson score	Good	12	93.5±0.67
	Excellent	8	97±0.53
	Fair	4	83.75±1.26
	Poor	1	78

Table 4: Dennis-Brown Classification of Fracture amongst the Study Group

Dennis-Brown Classification	Frequency	%
A	11	44%
B	14	56%
Total	25	100%
Invalid	0	0%
Total	25	100%

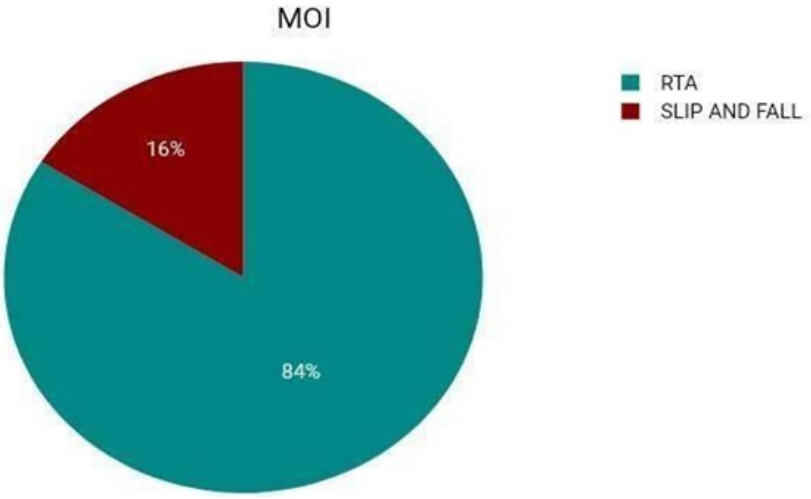

Figure 2: Mechanism of Injury

Table 5: Side Involved Amongst the Study Group

Side involved	Frequency	%
RIGHT	17	68%
LEFT	8	32%
Total	25	100%
Invalid	0	0%
Total	25	100%

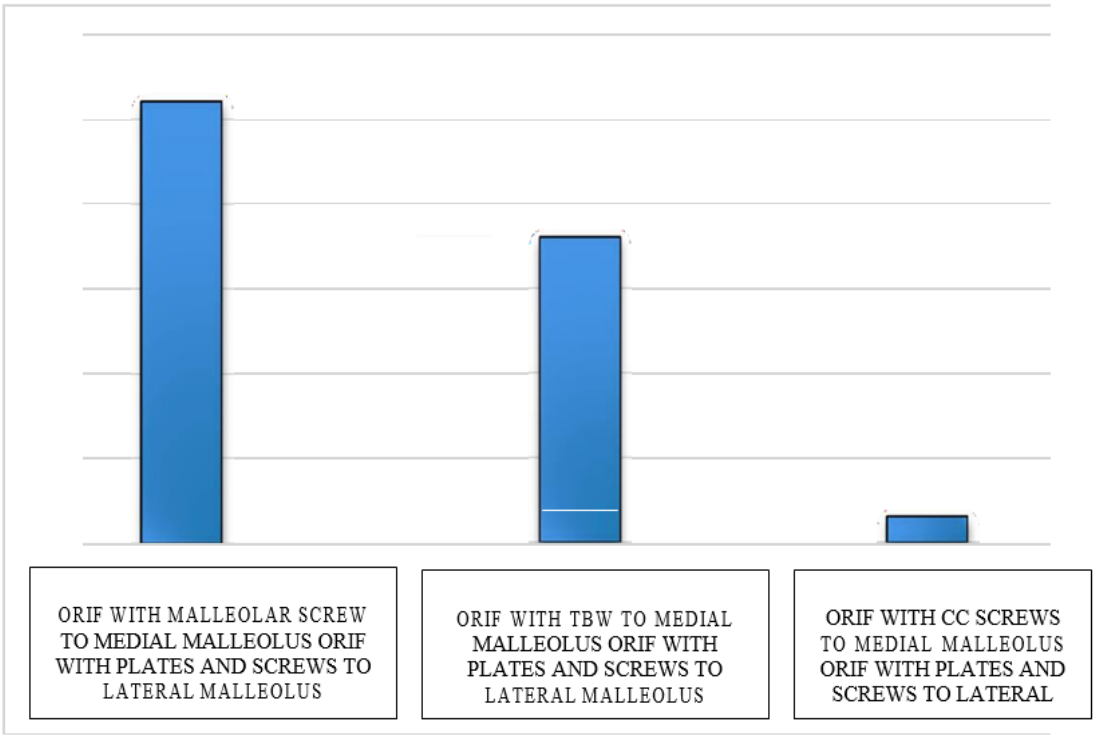

Figure 3: Procedure Performed in the Study Group

Discussion

Pott's fracture, an archaic term for bimalleolar fractures, was first described by English physician Percivall Pott in 1765. Dupuytren (1819) introduced a scientific approach to studying the injury's mechanism. Over time, advancements by researchers like Lauge-Hansen, Rockwood, Green, Vasil, Jergen, Burwell, and Charnley have shifted management towards safer fixation techniques and earlier surgical interventions. Anatomical restoration is crucial, as most fractures are difficult to reduce with closed techniques due to soft tissue interposition. Mohapatra et al. (2019) reported a mean patient age of 43.8 years, consistent with the current study [19].

In Dwivedi et al., the mean age was 40.10 (±12) years, similar to our findings. Gangadharan et al. reported a mean age of 43 years, also consistent with our study. Shyam et al. found most patients were aged 41-50 (35%). Gaurav et al. noted a similar age distribution, with a mean age of 46.775 (±15.432). Kumar et al. included patients aged above [19,20,21,22,23,24]. In the present study, 64% were males and 36% were females, consistent with Mohapatra et al. (48 males, 36 females), Gangadharan et al. (58.33% males), and Dwivedi et al. (male-to-female ratio 1.9:1). Shyam Kumar et al. found a 3:2 male-to-female ratio, while Arun Kumar et al. reported 20 males and 10 females. Gaurav et al. observed 57.5% males and 42.5% females [19,20,21,22,23,24].

In the present study, 68% of injuries were on the right side, similar to Mohapatra et al. (52/84), Dwivedi et al. (62.06%), and Gangadharan et al. (54.16%). Arun Kumar et al. observed 15 right-sided and 13 left-sided fractures, with 2 bilateral cases. Gaurav et al. reported 42.5% right-side and 57.5% left-side involvement [19, 20,21,23,24].

In our study, 84% of bimalleolar injuries were caused by road traffic accidents (RTA), consistent with findings from Mohapatra et al. and Gangadharan et al., who reported 52.08% RTAs. Kumar et al. noted 30% were due to RTAs, while Arun Kumar et al. also found RTAs as the most common cause of injury [19,21,24]. Gaurav et al. reported that 72.5% of injuries were due to road traffic accidents, similar to our study. In our study, 56% had Dennis-Brown type B fractures, which

aligns with Mohapatra et al. (49/84) and Gaurav et al. (50%). However, Dwivedi et al. found type a more common (51.73%), differing from our findings due to more severe injury mechanisms [19,20,23]. In our study, ORIF with malleolar screws to the medial malleolus and plates to the lateral malleolus was the most common surgery (13 cases), followed by tension band wiring (9 cases). Shyam Kumar et al. reported 45% used malleolar screws for medial malleolus, while Gangadharan et al. primarily used cannulated cancellous screws. Arun Kumar et al. noted the most common fixation for lateral malleolus was one-third tubular plates, with CCS for the medial malleolus [21,22,24].

In our study, 12 participants had good outcomes (mean score 93.5±0.67) and 8 had excellent outcomes (mean score 97±0.53). Mohapatra et al. reported excellent outcomes in 17 cases, while Gaurav et al. noted 77.5% with good results. Gangadharan et al. observed 43.75% with excellent results, and Shyam et al. found 75% excellent outcomes. Kale et al. reported 62% with excellent results, while Arun Kumar et al. observed significant post-op improvement [19,21,22,23,24,25].

In our study, ORIF with malleolar screw to the medial malleolus and plate to the lateral malleolus resulted in 3 cases of ankle stiffness and 1 of superficial infection. Shyam Kumar et al. observed persistent pain, joint stiffness in 3 patients, and infections in 3. Gangadharan et al. reported 8.33% post-op infections, while Arun Kumar et al. noted significant post-op score improvement [21,22,24].

Conclusion

Surgical correction of bimalleolar fractures is now the primary approach due to its association with better reduction, less pain, fewer complications, and improved outcomes. Conservative management is limited to smaller fractures unsuitable for surgery. As ankle fractures are inherently unstable, they require proper anatomical reduction, adequate fixation, and postoperative rehabilitation. A wide range of implants is available for surgical management, with their selection depending on the fracture's nature, ease of use, and the surgeon's training. The combination of appropriate implants and surgical techniques leads to more successful management of these complex injuries.

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Declarations

Ethical approval: The study was conducted after obtaining permission from the Institutional Ethics Committee (IEC) at Kempegowda Institute of Medical Sciences. All the data collected as a part of this study was kept confidential. Patient's identity will never be disclosed

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