



## Functional Outcome of Open Reduction and Internal Fixation in Bimalleolar Fractures of Ankle

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### Declaration

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### ABSTRACT

**Objective:** To determine the functional outcome of open reduction and internal fixation (ORIF) in patients with bimalleolar fractures of the ankle. **Study Design:** Descriptive study. **Place and Duration of Study:** Department of Orthopedic Surgery, Hayatabad Medical Complex (HMC), Peshawar, from August 2024 to February 2025. **Methodology:** Using a non-probability consecutive sampling method, 82 individuals with radiologically verified bimalleolar ankle fractures, ranging in age from 18 to 65 years, were included in the study. Conditional exclusion criteria included reduced feeling in the lower limbs and complicated fractures. Through the use of conventional surgical techniques, every subject underwent open reduction and internal fixation (ORIF). The Ankle-Hindfoot Scale developed by the American Orthopedic Foot and Ankle Society (AOFAS) was used to assess functional recovery forty-five days following surgery. Categorical variables were represented as frequencies and percentages in the statistical analysis carried out using SPSS version 25, while continuous variables were given as mean  $\pm$  standard deviation. The moderators of effects were evaluated using chi-square testing and stratification. **Results:** The mean age of patients was  $40.77 \pm 13.89$  years, and the mean BMI was  $26.56 \pm 6.89$  kg/m<sup>2</sup>. Of the 82 patients, 62.2% were male and 37.8% female. Mechanism of injury included road traffic accidents (45.1%), falls (24.4%), and other causes (30.5%). Functional outcome was excellent in 52 (63.4%) patients, good in 13 (15.9%), and fair in 17 (20.7%). **Conclusion:** The majority of patients with bimalleolar ankle fractures had excellent to good functional results after open reduction and internal fixation. To get the best possible outcome after surgery, prompt action and restoration of lost anatomy are essential.

### INTRODUCTION

The medial and lateral malleoli are both broken in bimalleolar ankle fractures, which make up a large portion of ankle injuries. Proper treatment is essential to prevent long-term problems and functional impairment caused by these fractures. They weaken the ankle joint's stability by tearing the mortise anatomy, which is a common result of high-impact trauma such as car accidents, falls, or sports injuries.<sup>1</sup>

Because it successfully realigns the anatomy, guarantees the stability of the joint, and allows for early mobilization, open reduction and internal fixation (ORIF) is considered the gold standard treatment for displaced bimalleolar fractures.<sup>2</sup> In both clinical practice and research contexts, the American Orthopedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Scale is utilized to assess functional results following surgery.<sup>3</sup>

Although international studies have demonstrated good to excellent results with ORIF in terms of pain relief, joint mobility, and prevention of post-traumatic arthritis.<sup>4-5</sup>

There is limited published data from Pakistan assessing the effectiveness of this intervention in local clinical practice. Variations in surgical technique, rehabilitation protocols, and patient compliance may influence outcomes, making local evidence essential for informed clinical decision-making.<sup>6</sup>

Given the increasing incidence of ankle injuries in our population and the paucity of local outcome-based data, this study was conducted to evaluate the functional outcome of ORIF in patients with bimalleolar fractures of the ankle using the AOFAS scoring system.

### METHODOLOGY

This descriptive study was conducted at the Department of Orthopedic Surgery, Hayatabad Medical Complex, Peshawar between August 2024 to February 2025 following ethical approval from the Institutional Research and Ethics Board (approval number 1730). The study enrolled 82 patients, with this sample size being determined using the WHO sample size calculator based

on a previously documented 13.79% rate of fair functional outcomes following open reduction and internal fixation for bimalleolar fractures, while maintaining a 95% confidence level and 7.5% margin of error.

We included patients of both genders aged 18-65 years presenting with radiologically confirmed bimalleolar ankle fractures, while excluding those with compound fractures or sensory impairment in the lower limbs. Participants were selected through non-probability consecutive sampling. After obtaining informed consent, we collected demographic information including age, gender, occupation, and residence, along with injury characteristics such as affected side and mechanism of injury.

All surgical procedures were performed under general anesthesia by an experienced orthopedic surgeon with at least five years of post-fellowship experience. The lateral malleolus was stabilized using either a one-third tubular plate or reconstruction plate, with supplemental syndesmotomic screw fixation when indicated. Medial malleolar fixation was achieved using either 4mm cannulated cancellous screws or tension band wiring, with the choice depending on individual fracture patterns.

Functional outcomes were evaluated at the 45-day postoperative mark using the validated AOFAS Ankle-Hindfoot Scale, with results categorized into four groups: excellent (90-100 points), good (80-89 points), fair (70-79 points), and poor (below 70 points).

For data analysis, we used SPSS version 25. Continuous variables including age, weight, height and BMI were expressed as means with standard deviations, while categorical variables such as gender, injury characteristics and functional outcomes were presented as frequencies and percentages. We employed stratification to account for potential effect modifiers including age, gender, BMI and injury mechanism, with post-stratification analysis using Chi-square tests where statistical significance was set at  $p < 0.05$ .

**RESULTS**

A total of 82 patients were included in this study. The mean age was  $40.77 \pm 13.89$  years, mean weight  $74.83 \pm 14.09$  kg, mean height  $1.70 \pm 0.11$  m, and mean BMI  $26.39 \pm 6.24$   $\text{kg/m}^2$  (Table 1).

Out of 82 patients, 51 (62.2%) were male and 31 (37.8%) were female. Employment status was evenly distributed with 41 (50.0%) employed and 41 (50.0%) unemployed. 47 (57.3%) patients resided in rural areas while 35 (42.7%) were from urban settings. Left-sided injury was noted in 45 (54.9%) patients and right-sided injury in 37 (45.1%). The most common mechanism of injury was road traffic accidents in 37 (45.1%) patients, followed by other causes in 25 (30.5%), and falls in 20 (24.4%) (Table 2). Based on the AOFAS Ankle-Hindfoot Scale, functional outcome was excellent in 52 (63.4%), fair in 17 (20.7%), and good in 13 (15.9%) patients.

Stratification of functional outcome by gender showed excellent outcomes in 32 (62.7%) males and 20 (64.5%) females, with no statistically significant difference ( $p = 0.972$ ) (Table 3). Regarding side of injury, excellent outcomes were observed in 29 (64.4%) left-sided and 23 (62.2%) right-sided fractures ( $p = 0.976$ ) (Table 4).

When stratified by mechanism of injury, excellent outcomes were reported in 14 (70.0%) patients with falls, 14 (56.0%) with other mechanisms, and 24 (64.9%) with RTA-related fractures. The association was not statistically significant ( $p = 0.370$ ) (Table 5). The overall functional outcome distribution is depicted in Figure 1.

**Table 1**

*Descriptive Statistics of Study (n = 82)*

| Variable                | Mean  | Std. Deviation |
|-------------------------|-------|----------------|
| Age (years)             | 40.77 | 13.89          |
| Weight (kg)             | 74.83 | 14.09          |
| Height (m)              | 1.70  | 0.11           |
| BMI ( $\text{kg/m}^2$ ) | 26.39 | 6.24           |

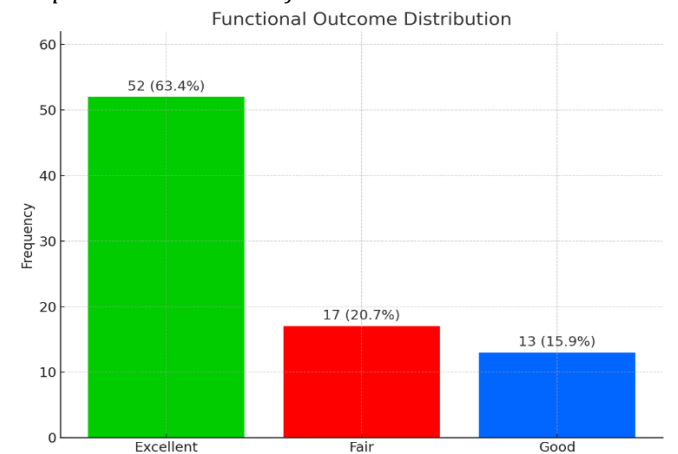
**Table 2**

*Demographic and Clinical Characteristics of Study Participants (n=82)*

| Variable            | Category     | Frequency | Percent (%)    |
|---------------------|--------------|-----------|----------------|
| Gender              | Male         | 51        | 62.2%          |
|                     | Female       | 31        | 37.8%          |
| Occupation Status   | Employed     | 41        | 50.0%          |
|                     | Unemployed   | 41        | 50.0%          |
| Place of Residence  | Rural        | 47        | 57.3%          |
|                     | Urban        | 35        | 42.7%          |
| Side of Injury      | Left         | 45        | 54.9%          |
|                     | Right        | 37        | 45.1%          |
| Mechanism of Injury | Fall         | 20        | 24.4%          |
|                     | Other<br>RTA | 25<br>37  | 30.5%<br>45.1% |

**Figure 1**

*Graphical Presentation of Functional Outcome Distribution*



**Table 3**

*Stratification of Functional Outcome Distribution with Gender (n=82)*

|                    | Gender       |              | Total        | P Value     |       |
|--------------------|--------------|--------------|--------------|-------------|-------|
|                    | Male         | Female       |              |             |       |
| Functional Outcome | Excellent    | 32<br>62.7%  | 20<br>64.5%  | 52<br>63.4% | 0.972 |
|                    | Fair         | 11<br>21.6%  | 6<br>19.4%   | 17<br>20.7% |       |
|                    | Good         | 8<br>15.7%   | 5<br>16.1%   | 13<br>15.9% |       |
| Total              | 51<br>100.0% | 31<br>100.0% | 82<br>100.0% |             |       |

**Table 4**  
*Stratification of Functional Outcome Distribution with Side of Injury (n=82)*

|                    |           | Side of Injury |              | Total        | P Value |
|--------------------|-----------|----------------|--------------|--------------|---------|
|                    |           | Left           | Right        |              |         |
| Functional Outcome | Excellent | 29<br>64.4%    | 23<br>62.2%  | 52<br>63.4%  | 0.976   |
|                    | Fair      | 9<br>20.0%     | 8<br>21.6%   | 17<br>20.7%  |         |
|                    | Good      | 7<br>15.6%     | 6<br>16.2%   | 13<br>15.9%  |         |
| Total              |           | 45<br>100.0%   | 37<br>100.0% | 82<br>100.0% |         |

**Table 5**  
*Stratification of Functional Outcome Distribution with Mechanism of Injury (n=82)*

|                    |           | Mechanism of Injury |              |              | Total        | P Value |
|--------------------|-----------|---------------------|--------------|--------------|--------------|---------|
|                    |           | Fall                | Other        | RTA          |              |         |
| Functional Outcome | Excellent | 14<br>70.0%         | 14<br>56.0%  | 24<br>64.9%  | 52<br>63.4%  | 0.370   |
|                    | Fair      | 4<br>20.0%          | 8<br>32.0%   | 5<br>13.5%   | 17<br>20.7%  |         |
|                    | Good      | 2<br>10.0%          | 3<br>12.0%   | 8<br>21.6%   | 13<br>15.9%  |         |
| Total              |           | 20<br>100.0%        | 25<br>100.0% | 37<br>100.0% | 82<br>100.0% |         |

## DISCUSSION

In this study, open reduction and internal fixation (ORIF) for bimalleolar ankle fractures yielded excellent outcomes in 63.4% of patients, good outcomes in 15.9%, and fair outcomes in 20.7%. These findings are comparable to those reported by Gaurav et al., who documented 64% excellent and 20% good functional outcomes using similar surgical techniques and evaluation criteria<sup>7</sup>.

Dwivedi et al. conducted a descriptive cross-sectional study at a tertiary care center and found 65.5% excellent, 20.7% good, and 13.8% fair outcomes, reinforcing the reliability of ORIF in restoring ankle function<sup>8</sup>. Similarly, Singh et al. observed excellent outcomes in 43.8% and good outcomes in 39.6% of patients with bimalleolar fractures managed with ORIF, using the AOFAS score as the assessment tool<sup>9</sup>.

In our study, road traffic accidents were the most frequent cause of injury (45.1%), followed by other trauma (30.5%) and falls (24.4%). This pattern differs slightly from that reported by Lakhani et al., where falls constituted the leading cause of bimalleolar fractures, followed by vehicular accidents<sup>10</sup>. This variation could be attributed to different population demographics and regional risk exposures.

Gender-wise analysis revealed no statistically significant difference in functional outcome ( $p = 0.972$ ), a finding supported by Shukla et al., who emphasized that gender does not influence postoperative recovery if fixation and rehabilitation protocols are appropriately followed<sup>11</sup>.

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Similarly, no significant difference in functional outcome was observed between left- and right-sided ankle fractures ( $p = 0.976$ ), aligning with results reported by Gaurav et al., who found no lateralization effect on recovery after ORIF<sup>7</sup>. While analyzing outcomes based on mechanism of injury, patients with fall-related fractures demonstrated a slightly better functional outcome (70.0% excellent) compared to those injured in road traffic accidents (64.9%) and other mechanisms (56.0%). Although this difference was not statistically significant ( $p = 0.370$ ), it reflects the trend highlighted by Motwani et al., who suggested that low-energy trauma typically results in less soft tissue disruption and thus better recovery<sup>12</sup>.

Patel et al. reported similar findings, observing 75% excellent and 15% good outcomes in patients treated with screws and tension band wiring, confirming that appropriate fixation techniques play a pivotal role in outcome irrespective of trauma type<sup>13</sup>.

Despite the overall effectiveness of ORIF, certain complications such as infection, hardware irritation, and post-traumatic arthritis can occur, particularly with delayed presentation or suboptimal rehabilitation. Parvataneni et al. also noted these challenges in their prospective study on surgically managed bimalleolar fractures<sup>14</sup>. However, our study did not encounter major complications during the follow-up period.

Our findings are also supported by Shah and Arif, who emphasized that with timely surgical intervention and structured rehabilitation, satisfactory outcomes can be achieved even in complex ankle fractures<sup>15</sup>. Furthermore, the long-term outcomes observed by De Souza et al. affirmed that anatomical restoration of the ankle mortise significantly reduces the risk of degenerative changes and residual instability<sup>16</sup>.

The study does have certain drawbacks. Not all late-onset problems or long-term functional status could have been captured due to the small sample size and 45-day follow-up period. Findings may also not be applicable outside of the specific setting of the study since it only involved one institution. To confirm these findings, bigger cohort studies with longer follow-up periods should be conducted at multiple centers.

## CONCLUSION

Open reduction and internal fixation in bimalleolar ankle fractures resulted in predominantly excellent to good functional outcomes, demonstrating its efficacy in restoring joint stability and promoting early functional recovery. The lack of statistically significant differences across gender, side of injury, and mechanism of trauma suggests that surgical outcomes are consistently favorable across diverse patient subgroups. These findings reinforce the value of standardized surgical intervention and contribute to the limited regional data on functional recovery following bimalleolar ankle fracture fixation.

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