

## Original Article

# Comparison of Functional Outcome Between AP Lag Screws Versus Posterior Buttress Plating for Posterior Malleolar Fixation in Tri-Malleolar Ankle Fracture

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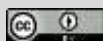


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## ABSTRACT

**Introduction:** Posterior malleolar fracture occurs commonly in up to 44% of all ankle fractures. Anterior to posterior lag screw or posterior buttress plate techniques are usually practiced for the operative management of such fractures. This study aimed to compare the functional outcome between anterior to posterior (AP) lag screw versus posterior buttress plating for posterior fixation in tri-malleolar ankle fracture. **Methods and materials:** This quasi-experimental study was conducted at the Department of Orthopedics & Traumatology, Chittagong Medical College Hospital, Chattogram, Bangladesh from November 2020 to October 2021. The study included 28 patients with ankle fractures, divided into two groups of 14 cases each. Group A received anterior to posterior (AP) lag screw fixation, while Group B underwent posterior buttress plating. Data analysis was performed using MS Office tools and SPSS version 23.0. **Result:** No statistically significant differences were observed in age ( $p = 0.64$ ), gender ( $p = 1.0$ ), or fracture

type ( $p = 0.71$ ) between the AP and posterior buttress plating groups. AOFAS scores showed significant correlations for pain ( $p = 0.045$ ) and function ( $p = 0.019$ ). Group A (AP lag screw) had satisfactory functional outcomes in 57% of cases, while Group B had 86% satisfaction. The range of motion in the affected ankle did not significantly differ between the two groups. **Conclusion:** In terms of AOFAS scores and functional outcomes, the buttress plating method for posterior fixation shows certain advantages over the anterior-to-posterior lag screw technique in the treatment of tri-malleolar ankle fractures.

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## INTRODUCTION

Ankle fracture is one of the most common injuries treated by orthopedic surgeons, accounting for 9% of all fractures and 36% of all lower extremity fractures in the United States, and the rate is still increasing particularly amongst young, active people as well as elder citizens because of aging-associated increases in fragility fractures [1-4]. Fixation with anterior to posterior (AP) screws relies on reduction of the posterior malleolus through ligamentotaxis of the posterior inferior tibiofibular ligament with reduction of the fibula, whereas fixation through a posterolateral approach allows direct reduction of the fracture [5,6]. It was found that patients with tri-malleolar ankle fractures in whom the posterior malleolus was treated with posterolateral buttress plating had superior clinical outcomes at follow-up compared with those treated with AP screws. Another prospective study showed that the direct reduction technique through a posterolateral approach provides a better quality of fracture reduction and functional outcome in the management of posterior malleolar fractures as compared with the indirect reduction technique [7]. The disadvantage of this method is the close relationship between the peroneal artery and perforating branches during proximal exposure for plate placement [8]. Despite the advantages described above, the direct reduction technique did not prevail over the indirect reduction technique in clinical practice [9]. It was reported that 83% of posterior malleolar fractures were fixed using AP screws with the indirect reduction technique [10]. Some authors believed that indirect reduction and

percutaneous screw fixation were less traumatic, while the posterolateral approach might increase the risk of posterior scarring, tendon impingement, and sural nerve injury [11,12]. It is to be noted that an author surveyed 401 orthopedic surgeons regarding their preference and indications for the choice of fixation between posterolateral plating and AP screws [9]. Among trauma-trained orthopedic surgeons, 72% preferred direct open reduction, while 53% of foot and ankle-trained surgeons and only 48% of surgeons without subspecialty training in trauma or foot and ankle preferred this approach. Despite the majority of trauma-trained surgeons choosing a direct open approach, only 56% selected posterolateral plating as their preferred method of fixation. In another study that compared the results of AP screws, posterior to anterior (PA) screws, and posterior buttress plates used in posterior malleolar fixation of tri-malleolar fractures, it was reported that PA screw and posterior buttress plate fixation with direct reduction using a posterolateral approach demonstrated significantly better radiological and functional outcomes than AP screw fixation following indirect reduction [13]. However, most of the evidence generated to date comes from retrospective record reviews. With this background, this study was conducted to compare the results of AP screws and posterior buttress plating in the posterior malleolar fixation of tri-malleolar fractures.

## OBJECTIVES

### General Objective

- To compare the functional outcome between anterior to posterior (AP) lag screw versus

posterior buttress plating for posterior fixation in tri-malleolar ankle fracture.

### Specific Objectives

- To see the age and gender distribution of the respondents.
- To compare baseline fracture characteristics between two groups.
- To compare range of motion (ROM) at the final follow-up between the two groups.

### METHODS AND MATERIALS

This quasi-experimental study was conducted at the Department of Orthopedics & Traumatology, Chittagong Medical College Hospital, Chattogram, Bangladesh, spanning from November 2020 to October 2021. The study comprised 28 patients with ankle fractures, divided into two groups of 14 cases each. Group A received anterior to posterior (AP) lag screw fixation, while Group B underwent posterior buttress plating. Written informed consent was taken from all the patients before data collection.

#### Inclusion criteria:

- Posterior malleolar fracture in tri-malleolar fractures with >2mm displacement, ankle instability, and fractures occurring within 14 days.
- Age 18 or older at surgery.

#### Exclusion criteria:

- Patients with additional lower extremity injury, pilon-type tri-malleolar fracture.
- Patients with open fractures, bilateral involvement, or multi-trauma cases.
- Patients with ankle arthritis (inflammatory or degenerative) or pathological fractures.

- Patients with comorbidities like diabetes mellitus, CKD, or chronic liver disease.

Patients undergoing surgery following pre-operative assessments had no specific criteria for fixation method selection. In the AP screw approach, patients were positioned supine, and direct incisions were made to fixate the fibula and medial malleolus. Subsequently, posterior malleolar reduction, aided by ligamentotaxis and fluoroscopy confirmation, was followed by fixation using one or two partially threaded 4.0 mm cannulated screws. A posterior lateral approach was employed to access the posterior malleolus between the peroneal tendons and flexor hallucis longus. During surgery, the posterior malleolus was directly reduced and provisionally fixed with K wires, followed by stabilization using a small fragment T plate or a 1/3 tubular plate in a buttress technique. Fibular fixation was done through the same incision, while medial malleolus fixation was performed separately through a medial approach. Intraoperative imaging assessed syndesmosis integrity, reinforced with a screw when necessary. Post-surgery, patients wore a plaster cast for three weeks, transitioning to a boot from weeks 2 to 6 for a range of motion and stretching exercises. Weight-bearing began at 6 weeks and progressed to full weight-bearing at 12 weeks. The final evaluation used AOFAS scores with subcategories: pain (out of 40), function (out of 45), and alignment (out of 15). Functional outcomes were classified as excellent (AOFAS score 90-100), good (AOFAS score 80-89), fair (AOFAS score 70-79), or poor (AOFAS score below 70). Dorsiflexion restriction status was compared with the unaffected side. Data was analyzed using SPSS version 23.0.

## RESULTS

In this study, the median age in Group A (AP lag screw) was 37.5 years, with an interquartile range (IQR) of 29.5-50.0 years, while in Group B (Posterior buttress plating), the median age was 39.5 years, with an IQR of 28.2-56.2 years. The p-value for age distribution was calculated as 0.628, indicating that there was no statistically significant difference in age between the two groups. Regarding gender distribution, both Group A and Group B had the same proportions. In each group, 71.4% of participants were male, and 28.6% were female. The p-value for gender distribution was calculated as 1.000, signifying that there were no statistically significant gender differences between the two groups. In the comparison of AOFAS (American Orthopaedic Foot & Ankle Society) scores at the final follow-up between Group A and Group B, significant differences were observed in several categories. For the "Pain" category, Group A had a median score of 30.0, with an interquartile range (IQR) of 30.0-30.0, while Group B had a median score of 30.0 with an IQR of 30.0-40.0. The p-value for pain was calculated as 0.045, indicating a statistically significant difference in pain scores between the two groups, with Group B reporting higher pain scores. In the "Function" category, Group A had a median score of 38.0, with an IQR of 34.0-42.0, whereas Group B had a

median score of 42.0, with an IQR of 40.0-45.0. The p-value for the function was calculated as 0.019, signifying a statistically significant difference in functional scores between the two groups, with Group B showing better functional outcomes. However, in the "Alignment" category, there was no statistically significant difference between the two groups. Both Group A and Group B had a median score of 15.0, with an IQR of 15.0-15.0. The p-value for alignment was 0.150. These findings suggest that while there were differences in pain and function scores, alignment scores were similar between the two groups at the final follow-up assessment. At the final follow-up assessment, ankle range of motion (ROM) was compared between two groups, Group A and Group B. The findings revealed that there were no significant differences in dorsiflexion, inversion, or eversion ROM between the two groups. While plantar flexion displayed a trend towards improvement in Group B compared to Group A, this difference did not reach statistical significance. Overall, these results suggest that both groups exhibited comparable ankle ROM at the final follow-up, indicating that the chosen treatments had similar effects on ankle mobility. In our study, Group A exhibited a satisfactory (Excellent and Good) functional outcome in 57% of cases, while Group B showed a satisfactory outcome in 86% of cases.

**Table I: Age and gender distribution of participants (N=28)**

Variables	Group A	Group B	P-value
	(n=14)	(n=14)	
<b>Age (Year)</b>			
<b>Median (IQR)</b>	37.5 (29.5-50.0)	39.5 (28.2-56.2)	0.628*
<b>Range</b>	24-55	20-80	
<b>Gender</b>			
<b>Male</b>	10 (71.4%)	10 (71.4%)	1.000†
<b>Female</b>	4 (28.6%)	4 (28.6%)	

IQR: Interquartile range. \*Mann-Whitney U test; †Fisher's exact test.

**Table II: AOFAS scores at final follow-up**

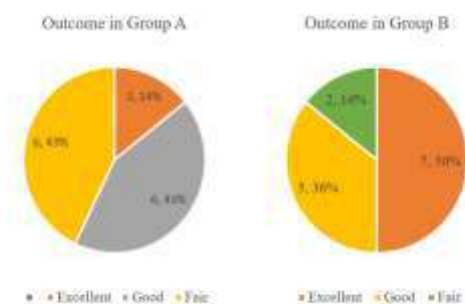
AOFAS scores	Group A	Group B	P-value*
<b>Pain</b>	30.0 (30.0-30.0)	30.0 (30.0-40.0)	0.045
<b>Function</b>	38.0 (34-42.0)	42.0 (40-45.0)	0.019
<b>Alignment</b>	15.0 (15.0-15.0)	15.0 (15.0-15.0)	0.150

\*Mann-Whitney U test.

**Table III: Range of motion (ROM) at final follow-up**

Ankle movement	Group A	Group B	P-value*
	ROM in degree		
<b>Dorsiflexion</b>	13.5 (10.8-15.0)	14.5 (12.0-16.0)	0.255
<b>Planter flexion</b>	38.0 (35.8-40.0)	40.0 (38.8-41.3)	0.085
<b>Inversion</b>	15.0 (13.8-15.3)	15.0 (13.8-16.0)	0.394
<b>Eversion</b>	6.5 (5.0-8.5)	7.0 (5.8-10.0)	0.308

\*Mann-Whitney U test.



**Figure 1: Functional outcome in both groups**

## DISCUSSION

Although there is almost no debate about the surgery for displaced medial and lateral malleolar fractures, the indications for the fixation of the posterior malleolar fragment and the fixation techniques in tri-malleolar fractures accompanied by a posterior malleolar fracture are still not clear, and there are several controversies in the management of posterior malleolar fractures [14,15]. To select a better surgical option, this study compared the outcomes of posterior malleolar fractures treated with posterior buttress plating versus AP lag screw fixation. The present study demonstrated that patients had superior clinical outcomes with posterior buttress plating. Patients in the posterior buttress plating group had significantly better AOFAS scores and improved ROM at the final follow-up, measured in dorsiflexion, plantar flexion, and eversion. In the present study, the age range of participants was between 20 to 80 years (Group B), with a median age of around 40 years (37.5 years in the AP screw group and 39.5 years in the posterior buttress plating group). This age distribution was comparable to findings from other studies. For example, Kalem et al. (2018) reported mean ages of 43.4 years and 40.8 years in the AP screw

group and posterior buttress plating group, respectively [13]. In the study by O'Connor et al. (2015), a somewhat higher mean age was reported (45.5 years in the AP screw group and 47.8 years in the posterior buttress plating group) [6]. In terms of gender distribution, the majority of patients in this study were male. This male predominance contrasts with findings from other studies where either female was the majority or the male-to-female ratio was nearly equal [13,16]. In our study, during the final follow-up, our findings revealed that the median AOFAS score was significantly better in the posterior buttress plating group compared to the AP lag screw group (88 versus 81). This indicates a superior functional outcome associated with posterior plating as opposed to the AP screw fixation ( $p=0.008$ ). Furthermore, in the posterior buttress plating group, half of the patients achieved excellent functional outcomes, whereas, in the AP lag screw group, only 14.3% reached this level. These results align with previous studies. For instance, O'Connor et al. (2015) conducted a study comparing AP screw fixation with plate fixation and found that patients treated with plate fixation exhibited better SMFA (Short Musculoskeletal Function Assessment) scores due to the direct restoration of articular anatomy [6]. Similarly, in the study conducted by Kamel et al. (2018), better AOFAS scores were observed in the posterior plating group compared to the AP screw fixation group ( $p < 0.05$ ). This difference in outcomes can be attributed to the improved reduction of fracture fragments achieved through direct visualization and early active motion with rigid fixation [13]. Shi et al. (2017) reported that higher-quality fracture reduction and better functional outcomes were achieved when PMFs were treated with the direct reduction

technique through a posterolateral approach [7]. Some other studies also demonstrated that fractures fixed with posterior buttress plating exhibited significantly less permanent and peak axial displacement during cyclical loading compared to those fixed with AP lag screws [17,18]. The posterior buttress plating approach offers several advantages over anterior-to-posterior fixation, as highlighted by Talbot et al. (2005) and O'Connor et al. (2015) [6,19]. In our study, none of the patients exhibited signs of instability or loss of reduction on direct radiographs during the follow-up period, which was consistent with the findings of a previous study [20]. The posterior approach offers the advantage of being able to fix smaller fracture fragments that may not be effectively stabilized with anterior-to-posterior screws. Additionally, fixation with a buttress plate provides improved biomechanical stability to the fracture, particularly in resisting shear forces.

#### **LIMITATIONS OF THE STUDY**

Multiple limitations were acknowledged. The study was confined to a single hospital, restricting generalizability. A small sample size might not have fully captured diverse experiences. Short patient follow-up raised concerns about long-term effects. Plain radiography, instead of computed tomography, could limit diagnostic precision. These collectively underscore the need for caution when applying the findings to larger, more diverse populations or comparing them to studies using advanced imaging techniques.

#### **CONCLUSION**

Based on the assessment of AOFAS (American Orthopaedic Foot & Ankle Society) scores and functional outcomes, it becomes evident that the

buttress plating method offers distinct advantages over the AP lag screw technique in treating tri-malleolar ankle fractures. Our findings underscore that patients treated with the buttress plating method tend to achieve superior AOFAS scores and more favorable functional outcomes. This suggests that the posterior fixation approach provides enhanced stability and support, contributing to better patient outcomes in terms of ankle function and overall quality of life. While both techniques may have their merits, the buttress plating method emerges as a compelling option for orthopedic surgeons when addressing tri-malleolar ankle fractures. Nonetheless, it is essential to recognize that individual patient factors and specific fracture characteristics should always be considered when determining the most suitable treatment approach. Further research and clinical studies may provide additional insights into the nuances of these techniques, ultimately guiding clinicians in making informed decisions for optimal patient care.

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**Conflict of interest:** None declared.

**Ethical approval:** The study was approved by the institutional ethics committee.

## RECOMMENDATION

According to the findings of this study, it is suggested that posterior buttress plating for posterior malleolar fracture fixation in tri-malleolar ankle fractures may be considered a preferable alternative to anterior-posterior (AP) screw fixation.

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