

Original Research Article

Comparison of American orthopedic foot and ankle society score between anterior to posterior lag screws versus posterior buttress plating for posterior malleolus fixation in tri-malleolar ankle fracture

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ABSTRACT

Background: Posterior malleolar fractures are frequent, occurring in up to 44% of all ankle fractures. Surgical management typically involves anterior to posterior (AP) lag screws or posterior buttress plates. This study aimed to compare the AOFAS (American orthopedic foot and ankle society) score between AP lag screw and posterior buttress plating for posterior malleolus fixation in tri-malleolar ankle fracture.

Methods: This quasi-experimental study was conducted at the department of orthopedics and traumatology, Chittagong medical college hospital, Chattogram, Bangladesh, from November 2020 to October 2021. It involved 28 patients with ankle fractures, equally divided into two groups. Group A received AP lag screw fixation, and group B underwent posterior buttress plating. Data analysis was performed using MS office tools and SPSS version 23.0.

Results: The posterior plating group demonstrated superior postoperative AOFAS scores compared with the AP screw group with statistically significant differences (88 versus 81, $p=0.008$). Significant differences were noted in the AOFAS pain score ($p=0.045$) and function score ($p=0.019$) at the final follow-up between the two groups.

Conclusions: Patients with tri-malleolar ankle fractures in whom the posterior malleolus is treated with posterior buttress plating show superior postoperative AOFAS scores at follow-up compared to those treated with AP screws.

Keywords: Ankle fracture, AOFAS score, Posterior buttress plating, Lag screws

INTRODUCTION

Ankle fractures rank among the most common lower extremity injuries. With increasing life expectancy and sustained physical activity in adults, it is anticipated that the incidence of ankle fractures will continue to rise in the coming decades.¹ While there is a clear consensus regarding the treatment of lateral and medial malleolar fractures, the criteria for posterior malleolar fragment fixation in tri-malleolar fractures have yet to be

definitively outlined.² Despite broad agreement on surgical intervention for displaced medial and lateral malleolar fractures, the indications and techniques for fixing posterior malleolar fragments in tri-malleolar fractures remain ambiguous.³ Consequently, several controversies persist in the management of posterior malleolar fractures.⁴ The AOFAS serves as a valuable scoring system for evaluating and tracking patient progress following foot and ankle surgery.⁵ This scoring system is frequently employed in assessing treatment outcomes for

patients who have sustained complex ankle or hindfoot injuries. It consists of both clinician-reported and patient-reported components.⁶ In the context of ankle fixation, orthopedic surgeons have at their disposal various fixation techniques for addressing posterior malleolar fractures. Among these options, AP screws are commonly employed in conjunction with an indirect approach, while plates or screws are utilized for a direct approach. Notably, posterolateral plating has demonstrated superior scores in short musculoskeletal function assessment (SFMA-36) when compared to AP screws.⁷ Fixation using AP screws relies on the reduction of the posterior malleolus through the ligamentotaxis of the posterior inferior tibiofibular ligament, along with the reduction of the fibula.⁸ In contrast, fixation through a posterolateral approach allows for the direct reduction of the fracture. In a retrospective comparative study, patients with tri-malleolar ankle fractures who received posterior malleolar treatment through posterolateral buttress plating demonstrated superior clinical outcomes during follow-up in comparison to those treated with AP screws.⁹ Despite these advantages, the direct reduction technique did not become the prevailing choice in clinical practice.¹⁰ Interestingly, it was reported that 83% of posterior malleolar fractures were addressed using AP screws with the indirect reduction technique.¹¹ Some experts argued that the indirect reduction method and percutaneous screw fixation were less traumatic, while the posterolateral approach might raise concerns about posterior scarring, tendon impingement, and sural nerve injury.^{12,13}

Objectives

General objective

General objective were to compare of AOFAS score between AP lag screw vs posterior buttress plating for posterior malleolus fixation in tri-malleolar ankle fracture and to compare function score between AP lag screw vs posterior buttress plating for posterior malleolus fixation in tri-malleolar ankle fracture.

Specific objectives

Specific objectives were to see the age and sex distribution of the study population.

METHODS

This quasi-experimental study was conducted at the department of orthopedics and traumatology, Chittagong medical college hospital, Chattogram, Bangladesh, spanning from November 2020 to October 2021. The study involved 28 patients with ankle fractures, and they were divided into two groups, each comprising 14 cases. Group A received AP lag screw fixation, while group B underwent posterior buttress plating. It's important to note that all patients provided written informed consent before the commencement of data collection.

Inclusion criteria

Patients with posterior malleolar fracture in tri-malleolar fractures with displacement over 2 mm and ankle instability and fracture within 14 days, age 18 years or older at the time of surgery and patients who had given consent to participate in the study were included in study.

Exclusion criteria

Patients with additional ipsilateral or contralateral lower extremity injury, pilon-type tri-malleolar fracture. patients with open fractures, bilateral involvement, and multi-trauma cases, patients who had ankle arthritis, and pathological fractures, patients with comorbidity- Diabetes mellitus, chronic kidney disease, chronic liver disease and patients who did not give consent to participate in the study were excluded.

In this study, patients undergoing surgery for ankle fractures lacked specific criteria for fixation method selection. Two different approaches were employed. The first approach involved the AP screw technique. Patients were positioned supine, and direct incisions were made to fixate the fibula and medial malleolus. The posterior malleolar reduction was confirmed using fluoroscopy after ligamentotaxis, and fixation was achieved using 4.0 mm cannulated screws. The second approach, the posterior lateral approach, accessed the posterior malleolus between the peroneal tendons and flexor hallucis longus. The posterior malleolus was directly reduced and provisionally fixed with K wires during surgery. Stabilization was accomplished using either a small fragment T plate or a 1/3 tubular plate in a buttress technique. Fibular fixation was also performed through the same incision, and medial malleolus fixation used a separate medial approach. Syndesmosis integrity was assessed during surgery, and additional screw fixation was applied when necessary. Post-surgery, patients were immobilized in a plaster cast for three weeks, followed by transitioning to a boot from weeks 2 to 6 for a range of motion exercises. Weight-bearing started at 6 weeks, gradually progressing to full weight-bearing at 12 weeks. The final evaluation utilized AOFAS scores, categorizing outcomes as excellent (90-100), good (80-89), fair (70-79), or poor (below 70) in subcategories of pain (out of 40), function (out of 45), and alignment (out of 15). Dorsiflexion restriction status was compared with the unaffected side. Data analysis was performed using SPSS version 23.0.

RESULTS

In this study, the median age in the AP screw group was 37.5 years, and in the posterior buttress plating group, it was 39.5 years. Males constituted the majority in both groups, with a prevalence of 71.4% in each group. However, it's worth noting that both groups were similar in terms of age and sex distribution. AOFAS scoring system is a clinical scoring system. It is subdivided into three parts i. pain score, ii. Function score, iii. Alignment

score. In the pain score assessment, which ranged from 40 (no pain) to 0 (severe, persistent pain), the final follow-up in our study showed a median pain score of 30 in both the buttress plate group (with a range of 30-40) and the AP screws group (with a range of 30-30). However, it's worth noting that the clinical outcome, as measured by the pain score, was significantly better in the posterior buttress group, with a p-value of 0.045. Similarly, during the final follow-up, the total function score was 38 (with a range of 34-42) in the AP screw group and 42 (with a range of 40-45) in the posterior buttress plating group. The function score, another component of clinical outcome assessment, was also significantly better in the posterior buttress plating group, with a p=0.019. As for the alignment score, which ranged from 15 (a good, plantigrade foot with well-aligned midfoot) to 0 (poor, non-plantigrade foot with severe malalignment and symptoms), both groups had the same score in the final follow-up. The Function score comprises components such as activity limitation and support requirements, footwear requirements, maximum walking distance (blocks), walking surface, and gait abnormality. For activity limitations, a score of 10 signifies no limitations, while a score of 0 indicates severe limitations. The buttress plating group had a median score of 10 (ranging from 7 to 10), whereas the AP screw group had a median score of 7 (ranging from 7 to 10), and this difference was statistically significant (p=0.007). Both study groups had the same median footwear requirement score of 5, and the difference was not statistically significant. In terms of maximum walking distance, the median score was 7 in the buttress plating group (ranging from 7 to 10) and 7 in the AP group (ranging from 7 to 7), with a statistically significant difference (p=0.023). Walking Surface showed that both groups had a median score of 10, and this difference was statistically significant. The Gait Abnormality score was the same in both study groups, with a median score of 10, and the difference was not statistically significant. In the final follow-up, the median AOFAS score was significantly better in the posterior buttress plating group (88, with a range of 77-100) compared to the AP leg screw group (81, with a range of 72-90). This difference in AOFAS scores between the two groups was statistically significant (p=0.008).

Table 1: Age and sex distribution of the participants, (n=28).

Variables	AP lag screw, n=14 (%)	Posterior buttress plating, n=14 (%)	P value
Age (In years)			
Median (IQR)	37.5 (29.5-50.0)	39.5 (28.2-56.2)	0.628*
Range	24-55	20-80	
Gender			
Male	10 (71.4)	10 (71.4)	1.0
Female	4 (28.6)	4 (28.6)	

*Mann-Whitney U test.

Table 2: Comparing AOFAS scores at final follow-up between two groups, (n=28).

AOFAS scores	AP leg screw, (n=14)	Posterior buttress plating, (n=14)	P value*
Pain	30 (30-30)	30 (30.0-40.0)	0.045
Function	38 (34-42.0)	42 (40-45.0)	0.019
Alignment	15 (15-15)	15 (15.0-15.0)	0.150

*Mann-Whitney U test.

Table 3: Comparison of function scores at final follow-up between two groups, (n=28).

Function scores	AP leg screw, (n=14)	Posterior buttress plating, (n=14)	P value*
Activity limit	7 (7-10)	10 (7-10)	0.026
Footwear	5 (5-5)	5 (5-5)	0.150
Walking distance	7 (7-7)	7 (7-10)	0.047
Walking surface	10 (5-10)	10 (10-10)	0.027
Gait abnormality	10 (10-10)	10 (10-10)	0.317

*Mann-Whitney U test

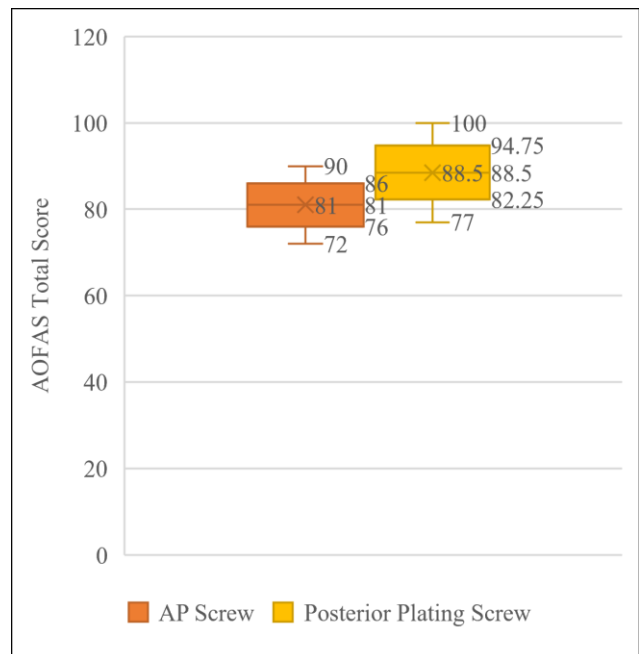


Figure 1: Comparison of AOFAS total score, (n=28). P=0.008, obtained from the Man-Whitney U test.

DISCUSSION

In the current study, the age range of participants spanned from 20 to 80 years, with a median age of approximately 40 years (37.5 years for the AP screw group and 39.5 years

for the posterior buttress plating group). These age characteristics were consistent with findings in other studies. For instance, a study by Kalem et al reported mean ages of 43.4 years and 40.8 years for the AP screw group and posterior buttress plating group, respectively.¹⁴ In a previous study, slightly higher ages were reported (45.5 years for the AP screw group and 47.8 years for the posterior buttress plating group). Regarding gender distribution, the majority of patients in this study were male (71.4%).⁹ This could be attributed to cultural factors, where males typically have more active lifestyles and spend more time outdoors for livelihood, while females tend to stay indoors. However, this male predominance was not consistent with the findings of other studies, where either female was the majority or the male-to-female ratio was nearly equal.^{15,16} In this study, the primary focus was on assessing clinical outcomes using the AOFAS scoring system. The AOFAS score includes pain score, function score, and alignment score as components for evaluating clinical outcomes. The study results revealed that posterior buttress plating had a significantly better improvement in pain ($p=0.045$) and function scores ($p=0.019$) compared to the AP screw group. However, there was no significant difference in alignment scores between the two groups ($p=0.94$). Furthermore, at the final follow-up, it was observed that the posterior buttress plating group had significantly better median function scores for activity limitation ($p=0.026$), maximum walking distance ($p=0.047$), and walking surface ($p=0.027$) in comparison to the AP leg screw group. No statistically significant differences were found in the median function scores for footwear and gait abnormality ($p>0.05$). In terms of the AOFAS score, the posterior buttress plating group outperformed the AP leg screw group with a median score of 88 versus 81, indicating a better functional outcome associated with posterior plating over the AP screw ($p=0.008$). In the posterior buttress group, 50% of patients achieved excellent functional outcomes, whereas only 14.3% in the AP leg screw group attained the same level of excellence ($p=0.1$). These findings align with previous research results. O'Connor et al also conducted a comparison between AP screw fixation and plate fixation, noting better SMFA scores in patients treated with plate fixation due to the direct restoration of articular anatomy.⁹ Kamel et al reported superior AOFAS scores in the posterior plating group compared to the AP screw fixation group ($p<0.05$). This difference can be attributed to the better reduction of fragments with direct fracture visualization and early active motion with rigid fixation. In the current study, both methods (posterior buttress and AP leg screw) yielded excellent outcomes, consistent with the findings of Kalem et al and Shi et al compared the radiological and functional outcomes of PMF managed with direct or indirect reduction techniques and found that higher quality fracture reduction and better functional outcomes were achieved with the direct reduction technique through a posterolateral approach. Biomechanical studies conducted by Bennett et al and Anwar et al also confirmed that posterior malleolus fractures treated with posterior buttress plating exhibited

significantly less permanent and peak axial displacement during cyclical loading compared to fractures fixed with AP lag screws.^{14,16-18}

Limitations

The research was carried out at a solitary hospital with a limited number of participants, raising concerns about the generalizability of the findings to the broader population. Furthermore, the follow-up duration for patients was relatively brief. Additionally, the assessment of reduction relied on plain radiography rather than more advanced imaging techniques like computed tomography.

CONCLUSION

The findings of this study indicate that patients diagnosed with tri-malleolar ankle fractures benefit from superior postoperative AOFAS scores during follow-up when the posterior malleolus is managed through posterior buttress plating, as opposed to those treated with AP screws. These results emphasize the potential advantages of employing posterior buttress plating in such cases to enhance the patients' postoperative outcomes and overall recovery.

Recommendations

Using posterior buttress plating for fixing posterior malleolar fractures in tri-malleolar ankle fractures may be a superior option compared to AP screw fixation. Future long-term studies are needed to assess the impact of various anatomical reductions on post-traumatic arthrosis in both fixation methods.

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