ORIGINAL RESEARCH

To compare the American Orthopedic Foot and Ankle Society score between the use of anterior to posterior lag screws and posterior buttress plating for fixing the posterior malleolus in tri-malleolar ankle fractures

[1]Dr. Masuraj Atal Bihari Mandal, [2]Dr. Pappu Kumar, [3]Dr. Parimal Bhaskar, [4]Dr. (Prof) Bharat Singh, [5]Dr. (Prof) Rakesh Choudhary

[1,2,3]Senior Resident, [4]Professor and HOD, [5]Professor, Department of Orthopaedic, Patna Medical College and Hospital, Patna, Bihar, India

Corresponding Author
Dr. Pappu Kumar
Senior Resident, Department of Orthopaedic, Patna Medical College and Hospital, Patna, Bihar, India
Email: dr.pappu02@gmail.com

Received date: 22 March, 2024 Acceptance date: 24 April, 2024

ABSTRACT

Aim: To compare the American Orthopedic Foot and Ankle Society score between the use of anterior to posterior lag screws and posterior buttress plating for fixing the posterior malleolus in tri-malleolar ankle fractures. **Material and methods:** The research included a total of 60 patients who had ankle fractures. These patients were separated into two groups, with each group consisting of 30 instances. Group A was treated with AP lag screw fixation, while group B got posterior buttress plating. The research comprised patients who had posterior malleolar fracture in tri-malleolar fractures with displacement more than 2 mm, ankle instability, and fracture occurring within 14 days. The patients were 18 years or older at the time of surgery and had provided permission to participate in the study were included. The ultimate assessment included AOFAS scores, which classified outcomes into several categories based on a numerical range. These categories included outstanding (90-100), good (80-89), fair (70-79), and bad (below 70). The evaluation focused on three subcategories: pain (rated out of 40), function (rated out of 45), and alignment (rated out of 15). **Results:** The clinical outcomes measured by the American Orthopedic Foot and Ankle Society (AOFAS) score shows that pre-operatively, the scores were similar between the two groups (42.8 ± 8.1 for AP Lag Screw vs. 43.1 ± 7.9 for Posterior Buttress Plating, p = 0.84). At 6 weeks post-operatively, the Posterior Buttress Plating group had a higher mean AOFAS score (62.3 ± 8.8) compared to the AP Lag Screw group (58.5 ± 9.2), though the difference was not statistically significant (p = 0.21). By 12 weeks, the trend continued, with the Posterior Buttress Plating group scoring higher (75.2 ± 9.9 vs. 70.4 ± 10.5), but still not significantly different (p = 0.15). However, at 18 weeks, a significant difference emerged, with the Posterior Buttress Plating group achieving a mean AOFAS score of 84.1 ± 8.3 compared to 78.2 ± 8.9 in the AP Lag Screw group (p = 0.04). This indicates that the Posterior Buttress Plating technique may offer better long-term clinical outcomes. **Conclusion**: The results of this research suggest that patients who have been diagnosed with tri-malleolar ankle fractures have better postoperative AOFAS ratings during follow-up when the posterior malleolus is treated with posterior buttress plating, rather than AP screws. The findings highlight the potential benefits of using posterior buttress plating in these circumstances to improve the patients' surgical outcomes and overall recovery.

Keywords: Ankle fracture, AOFAS score, Posterior buttress plating, Lags crews

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 intri-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 hind foot 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 ligamentot axis 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.

MATERIAL AND METHODS

This research, which followed a quasi-experimental design, took place in the department of orthopedics. The research included a total of 60 patients who had ankle fractures. These patients were separated into two groups, with each group consisting of 30 instances. Group A was treated with AP lag screw fixation, while group B got posterior buttress plating. Prior to the initiation of data collection, it is crucial to emphasize that all patients have given written informed permission.The research comprised patients who had posterior malleolar fracture in tri-malleolar fractures with displacement more than 2 mm, ankle instability, and fracture occurring within 14 days. The patients were 18 years or older at the time of surgery and had provided permission to participate in the study were included.Patients having an extra injury to either the same side or opposite side of the lower limb, specifically a tri-malleolar fracture of the pilon type. Patients with pathological fractures, open fractures, bilateral involvement, and multi-trauma cases were excluded from the study. Additionally, patients with diabetes mellitus, chronic kidney disease, chronic liver disease, and patients who did not provide informed consent to participate in the study were not included. The research found that patients who were having surgery for ankle fractures did not have clear criteria for determining the appropriate type of fixation. Two distinct methodologies were used. The first method used the AP screw technique. The patients were placed in a supine posture, and incisions were done directly to stabilize the fibula and medial malleolus. The confirmation of posterior malleolar reduction was done using fluoroscopy following ligamentotaxis, and fixation was accomplished by employing 4.0 mm cannulated screws. The second method, known as the posterior lateral approach, included reaching the posterior malleolus by going between the peroneal tendons and flexor hallucis longus. During the surgical procedure, the posterior malleolus was immediately realigned and temporarily stabilized with K wires. Stabilization was achieved by using either a tiny fragment T plate or a 1/3 tubular plate in a buttress approach. In addition, fibular fixation was carried out using the same incision, but medial malleolus fixation was accomplished via a distinct medial approach. The integrity of the syndesmosis was evaluated intraoperatively, and supplementary screw fixation was implemented if needed. After the operation, patients were rendered immobile by being placed in a plaster cast for a duration of three weeks. Subsequently, they transitioned to wearing a boot from weeks 2 to 6, during which they performed exercises to improve their range of motion. Weight-bearing started at 6 weeks and rapidly advanced to complete weight-bearing by 12 weeks. The ultimate assessment included AOFAS scores, which classified outcomes into several categories based on a numerical range. These categories included outstanding (90-100), good (80-89), fair (70-79), and bad (below 70). The evaluation focused on three subcategories: pain (rated out of 40), function (rated out of 45), and alignment (rated out of 15). The status of dorsiflexion limitation was compared to the unaffected side. The data analysis was conducted using SPSS version 25.0.

RESULTS

The demographic characteristics of the patients in both groups were well-matched, as shown in Table 1. The mean age was 42.3 ± 10.2 years in the AP Lag Screw group and 41.8 ± 9.8 years in the Posterior Buttress Plating group, with a p-value of 0.82, indicating no significant difference. The gender

distribution was also comparable, with 16 males and 14 females in the AP Lag Screw group and 18 males and 12 females in the Posterior Buttress Plating group ($p = 0.64$). The BMI values were similar, with mean BMIs of 26.7 ± 3.5 kg/m² for the AP Lag Screw group and 27.1 ± 3.8 kg/m² for the Posterior Buttress Plating group ($p = 0.73$). Lastly, the duration of symptoms before surgery was almost identical, with 8.4 ± 2.3 days for the AP Lag Screw group and 8.1 ± 2.6 days for the Posterior Buttress Plating group ($p = 0.78$). These results confirm that the two groups were demographically similar, ensuring that any differences in clinical outcomes could be attributed to the surgical techniques rather than baseline patient characteristics.

Table 2 presents the clinical outcomes measured by the American Orthopedic Foot and Ankle Society (AOFAS) score at various time points. Pre-operatively, the scores were similar between the two groups (42.8 ± 8.1 for AP Lag Screw vs. 43.1 ± 7.9 for Posterior Buttress Plating, $p = 0.84$). At 6 weeks post-operatively, the Posterior Buttress Plating group had a higher mean AOFAS score (62.3 ± 8.8) compared to the AP Lag Screw group (58.5 ± 9.2), though the difference was not statistically significant ($p = 0.21$). By 12 weeks, the trend continued, with the Posterior Buttress Plating group scoring higher (75.2 ± 9.9 vs. 70.4 ± 10.5), but still not significantly different ($p = 0.15$). However, at 18 weeks, a significant difference emerged, with the Posterior Buttress Plating group achieving a mean AOFAS score of 84.1 ± 8.3 compared to 78.2 ± 8.9 in the AP Lag Screw group ($p = 0.04$). This indicates that the Posterior Buttress Plating technique may offer better long-term clinical outcomes.

Table 3 breaks down the AOFAS scores into pain, function, and alignment subscores. The Posterior Buttress Plating group showed significantly better pain relief, with a mean pain subscore of 31.2 ± 4.8 compared to 28.5 ± 5.2 for the AP Lag Screw group ($p = 0.03$). Functional outcomes were also better in the Posterior Buttress Plating group, with a mean function subscore of 38.9 ± 6.5 versus 35.7 ± 7.1 in the AP Lag Screw group ($p = 0.05$). The alignment subscores were similar between the two groups (14.3 ± 1.1 for Posterior Buttress Plating vs. 14.0 ± 1.2 for AP Lag Screw, $p = 0.18$), suggesting that both techniques are equally effective in achieving proper alignment. These findings highlight the advantages of Posterior Buttress Plating in terms of pain management and functional recovery.

Table 4 examines post-operative recovery and patient satisfaction. The length of hospital stay was similar between the two groups, with a mean stay of 3.5 ± 0.9 days for the AP Lag Screw group and 3.3 ± 1.0 days for the Posterior Buttress Plating group ($p = 0.37$), indicating no significant difference. However, patient satisfaction scores were significantly higher in the Posterior Buttress Plating group (8.3 ± 1.2) compared to the AP Lag Screw group (7.5 ± 1.3, $p = 0.04$). This higher satisfaction likely reflects the better clinical and functional outcomes associated with the Posterior Buttress Plating technique, emphasizing its potential benefits in improving patient-perceived outcomes.

Table 1: Demographic Characteristics

Characteristic	AP Lag Screw (n=30)	Posterior Buttress Plating (n=30)	P-Value
Age (years)	42.3 ± 10.2	41.8 ± 9.8	0.82
Gender (Male/Female)	16/14	18/12	0.64
BMI (kg/m²)	26.7 ± 3.5	27.1 ± 3.8	0.73
Duration of Symptoms (days)	8.4 ± 2.3	8.1 ± 2.6	0.78

Table 2: Clinical Outcomes (AOFAS Score)

Time Point	AP Lag Screw (n=30)	Posterior Buttress Plating (n=30)	P-Value
Pre-operative	42.8 ± 8.1	43.1 ± 7.9	0.84
6 weeks	58.5 ± 9.2	62.3 ± 8.8	0.21
12 weeks	70.4 ± 10.5	75.2 ± 9.9	0.15
18 weeks	78.2 ± 8.9	84.1 ± 8.3	0.04

Table 3: Functional Outcomes (AOFAS Subscores)

Subscore	AP Lag Screw (n=30)	Posterior Buttress Plating (n=30)	P-Value
Pain (out of 40)	28.5 ± 5.2	31.2 ± 4.8	0.03
Function (out of 45)	35.7 ± 7.1	38.9 ± 6.5	0.05
Alignment (out of 15)	14.0 ± 1.2	14.3 ± 1.1	0.18

Table 4: Post-operative Recovery and Satisfaction

Characteristic	AP Lag Screw (n=30)	Posterior Buttress Plating (n=30)	P-Value
Length of Hospital Stay (days)	3.5 ± 0.9	3.3 ± 1.0	0.37
Patient Satisfaction (1-10 scale)	7.5 ± 1.3	8.3 ± 1.2	0.04

DISCUSSION

The demographic characteristics of the patients in both groups were well-matched, ensuring a fair comparison of clinical outcomes. The mean age, gender distribution, BMI, and duration of symptoms before surgery were similar between the two groups, with p-values indicating no significant differences. This similarity in baseline characteristics helps isolate the effect of the surgical technique on the clinical outcomes. Similar matching was observed in a study by Miller et al.[12], where demographic characteristics between different surgical groups were also statistically comparable, ensuring the reliability of the comparative outcomes.Clinical outcomes were assessed using the American Orthopedic Foot and Ankle Society (AOFAS) score at various time points. Pre-operatively, the scores were nearly identical, which aligns with findings from previous studies that ensure baseline comparability.[13] At 6 and 12 weeks post-operatively, the Posterior Buttress Plating group had higher mean AOFAS scores than the AP Lag Screw group, although the differences were not statistically significant. These trends are consistent with research by Cooper et al.[14], who also observed improved early post-operative outcomes with buttress plating techniques.However, at 18 weeks post-operatively, the Posterior Buttress Plating group achieved a significantly higher mean AOFAS score, indicating superior long-term clinical outcomes. This finding is supported by similar results in the literature, where buttress plating has been shown to provide better long-term stability and functional recovery.[15]Functional outcomes, including pain, function, and alignment subscores, provide a detailed analysis of the effectiveness of the two surgical techniques. The Posterior Buttress Plating group showed significantly better pain relief and functional outcomes, as evidenced by higher pain and function subscores. This observation is in line with a study by Johnson et al.[16], which highlighted the advantages of buttress plating in improving pain management and functional performance . The alignment subscores were similar between the two groups, suggesting that both techniques are effective in achieving proper anatomical alignment, a finding echoed in the study by Green et al.[17]Post-operative recovery, measured by the length of hospital stay, was similar for both groups, indicating that the surgical technique did not significantly impact the immediate post-operative period. This finding is consistent with earlier studies by Park et al.[18], which found no significant difference in hospital stay between different fixation methods for ankle fractures. Patient satisfaction, however, was significantly higher in the Posterior Buttress Plating group. Higher satisfaction scores reflect the better clinical and functional outcomes associated with this technique, emphasizing its potential benefits in improving patient-perceived outcomes. This result aligns with research by Kim et al.[19], which also reported higher patient satisfaction with buttress plating due to improved functional recovery and pain management.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 results of this research suggest that patients who have been diagnosed with tri-malleolar ankle fractures have better postoperative AOFAS ratings during follow-up when the posterior malleolus is treated with posterior buttress plating, rather than AP screws. The findings highlight the potential benefits of using posterior buttress plating in these circumstances to improve the patients' surgical outcomes and overall recovery.

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