Original Research

POSTERIOR VERSUS LATERAL PLATING FOR LATERAL MALLEOLUS FRACTURES USING A POSTEROLATERAL APPROACH-A CLINICAL STUDY

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ABSTRACT

Background: Lateral malleolus fractures are the most frequently recorded ankle injuries. Most cases require operative fixation to restore optimal ankle mobility. Traditionally, lateral plating has been used to treat these kinds of injuries; however, problems related to implant prominence and soft-tissue complications have been reported. Recently, the posterolateral approach has emerged as an alternative technique with potential biomechanical and clinical advantages. The current study aimed to determine the posterior plating and lateral plating of lateral malleolus fractures using a posterolateral approach.

Methods: This prospective comparative clinical study was done in the department of orthopedics on 30 cases of displaced lateral malleolus fractures. They were allocated into two groups of (n=15) each. Group A received posterior plating, and Group B cases were treated by lateral plating. The surgical method in both cases was a posterolateral approach. Comparison of operative time, fluoroscopy time, radiological union, functional outcome using Olerud–Molander Ankle Score (OMAS), and complications was evaluated. All the cases were followed up for 6 months.

Results: Groups were comparable in terms of baseline characteristics, showing homogeneous distribution. The operative time was longer in posterior plating, and fluoroscopy time was lower in this group, with p-values showing significance. The overall radiological outcome, hospital stay, and time to full weight bearing were found to be similar in both groups. Functional outcomes were found to be significantly better in the posterior plating group, with higher mean OMAS scores, and minimal complications were recorded. Group B showed cases of implant irritation, and the need for implant removal was higher in this group compared to Group A.

Conclusion: The present study concluded that the posterior approach with posterior plating for displaced lateral malleolus fractures was superior compared to lateral plating with fewer complications and comparable radiological results. Therefore, this method should be preferred in feasible cases.

Keywords: Lateral Malleolus Fracture, Posterior Plating, Lateral Plating, Posterolateral Approach, Ankle Fracture Fixation.

INTRODUCTION

Ankle fractures are common fractures of the lower limb that are treated by orthopedic surgeons. Most of these ankle fracture involves the lateral malleolus, and reduction to its anatomical alignment is crucial for maintaining ankle stability, congruency of the ankle mortise, and long-term limb functions [1].

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Operative treatment is the common method for treatment of these displaced or unstable lateral malleolar fractures because it can achieve accurate reduction and restore early mobilization [2]. Plate osteosynthesis is the standard approach in most of these cases, and conventionally, one-third tubular, or locking plates by lateral approach have been employed because of simplicity and familiarity [3]. Nevertheless, there are some disadvantages associated with lateral plating. The lateral fibula is subcutaneous, and thus, the implant is likely to irritate the soft tissues, causing wound complications, and sometimes may require subsequent removal of the implant [4]. Because of these complications, there is an exploration for alternative approaches that can offer comparable

biomechanical stability and minimal soft tissue complications. Recently, posterior plating of the lateral malleolus utilizing a posterolateral approach has been the focus of attention. This technique allows placement of plate on the posterior surface of fibula because it is covered by thicker soft tissue it reduces the implant prominence and wound related problems [5]. Moreover, the posterior antiglide plating offers a biomechanically desirable construct, especially (oblique or spiral fractures) because it acts opposing the shear forces that easily lead to an anterior and proximal displacement of the distal fragment [6]. The posterolateral approach has advantages compared to simple plate positioning. It provides an option of direct visualization and fixation of anterior malleolar fragments when they are present without the requirement of an additional incision [7]. This is relevant in the context where the role of the posterior malleolus has been identified as a factor in determining the stability of the ankle and functional outcome. The technique also enables the fixation of the fibula and posterior malleolus simultaneously in prone or lateral positioning, which could potentially save on time spent performing the operation and soft-tissue manipulation [8]. Although these are the theoretical and biomechanical benefits, there have been concerns about the posterolateral approach and the posterior plating. These include the risk of sural nerve damage and limited exposure obtained by this approach in certain fracture patterns [9]. Few biomechanical studies have suggested superior and comparable stability with posterior plating; however, clinical evidence comparing the posterior and lateral plating in terms of functional outcomes, complication rates, and overall patients' satisfaction is limited and sometimes contradictory [10]. Therefore, an evaluation of posterior versus lateral plating for lateral malleolus fractures by the posterolateral approach can provide evidence regarding the clinical and functional outcomes. Based on this background, we in the current study tried to compare the two fixation methods with respect to fracture union, functional results, and complication rates in cases of lateral malleolus fractures reporting to our tertiary care teaching hospital.

MATERIALS AND METHODS

This prospective clinical study was conducted in the Department of Orthopaedics, Rajiv Gandhi Institute of Medical Sciences (RIMS), Adilabad, Telangana. Prior approval was obtained for the study from the Institutional Ethical Committee. The method of sample collection was a convenience sampling method. Successive cases of lateral malleolus fractures were included. Written informed consent was obtained from all the patients of the study after explaining the nature of the study and possible outcomes in the vernacular language.

Inclusion Criteria

1. Patients with closed lateral malleolus fractures (Weber B and Weber C) type
2. Displaced or unstable fractures require surgical intervention
3. Aged above 18 years
4. Males and females
5. Available for follow-up
6. Signed the informed consent

Exclusion Criteria

1. Pathological fractures of the lateral malleolus
2. Open fractures
3. Ipsilateral fracture of the foot
4. Neurovascular injuries around the ankle
5. Comorbidities prevent surgical intervention.

Based on the inclusion and exclusion criteria, a total of n=30 cases of lateral malleolus fractures requiring operative fixation were included in the study. The participants were randomly allocated to two groups based on a generated random number of n=15 each. Group A comprised patients who were treated with posterior plating of the lateral malleolus. Group B were patients who were treated with lateral plating of the lateral malleolus.

Preoperative Assessment: All the patients were evaluated for a history of the mode of accident, followed by a detailed clinical examination and radiographic assessment. Standard anteroposterior, lateral, and mortise view radiographs of the ankle were obtained. Based on the radiographs, a classification of the fracture was done, followed by surgical planning. The classification of fractures was done based on the Weber classification system. Preoperative laboratory investigations were performed, and an anesthetic evaluation was carried out in all cases.

Surgical Technique in brief: All the surgeries were performed in spinal anesthesia, and the patients were placed in prone or lateral position depending on feasibility. A posterolateral approach was used in both groups of cases. In the Group A cases, fixation of the lateral malleolus was performed using a posterior antiglide plate placed on the posterior surface of the fibula.

All surgeries were performed under spinal or general anesthesia with the patient placed in a prone or lateral position. A posterolateral approach to the ankle was used in both groups. In Group A, fixation of the lateral malleolus was performed using a posterior antiglide plate placed on the posterior surface of the fibula. In Group B, fixation was achieved using a one-third tubular or locking plate applied on the lateral surface of the fibula through the same posterolateral exposure. Additional fixation of associated posterior malleolar or medial malleolar fractures, when present, was carried out as required.

Postoperative care: Postoperatively, the limb was immobilized in a below-knee posterior splint. Intravenous antibiotics were administered for 48 hours, followed by oral antibiotics as per

institutional protocol. Sutures were removed on the 12th to 14th postoperative day. Non–weight–bearing ambulation was advised for the initial 6 weeks, followed by gradual progression to partial and then full weight bearing based on radiological evidence of fracture union.

Outcome Assessment: Patients were followed up at regular intervals at 6 weeks, 12 weeks, and 6 months postoperatively. Radiological assessment was performed to evaluate fracture union and implant position. Functional outcome was assessed using a standardized ankle scoring system. Complications such as wound infection, implant irritation, delayed union, and need for implant removal were documented and compared between the two groups.

Statistical Analysis: All the available data were refined, segregated, and uploaded to an MS Excel spreadsheet and analyzed by SPSS version 26 in Windows format. The continuous variables were represented as mean, standard deviation, and percentage, and the categorical variables were calculated by the chi-squared test for differences between two groups. Values of p (<0.05) were considered significant.

RESULTS

The baseline demographic characteristics of the cohort are presented in Table 1. Analysis of the table showed that the distribution of cases was comparable in both groups at baseline, showing good randomization. This minimizes the confounding factors that would affect the outcomes. The distribution of age showed that the mean age of Group A cases was 42.5 ± 11.8 years, and Group B was 39.8 ± 10.4 years, with no statistical differences. Male predominance was observed in both groups of cases because of the typical epidemiology of ankle fractures, and sex distribution was similar in both groups. The common cause of injury in both groups was road traffic accidents, falls, and sports-related injuries. The fracture pattern showed Weber B in 66.7% of cases and Weber C in 33.3% of cases. The mean time of surgery was found to be similar in both groups.

Table 1: Baseline Demographic and Fracture Characteristics

Characteristic	Group A (Posterior Plating)	Group B (Lateral Plating)	p-value
Age (Years) Mean ± SD	42.5 ± 11.8	39.8 ± 10.4	0.492
Sex (Male: Female)	11: 4	12: 3	0.678
Mechanism of Injury			
Simple Fall	9 (60%)	10 (66.7%)	0.752
Road Traffic Accident	5 (33.3%)	4 (26.7%)	
Sports Injury	1 (6.7%)	1 (6.7%)	
Weber Classification			
Weber B	10 (66.7%)	10 (66.7%)	1.000
Weber C	5 (33.3%)	5 (33.3%)	
Side of Injury			
Left	7 (46.7%)	8 (53.3%)	0.722
Right	8 (53.3%)	7 (46.7%)	
Time to Surgery (Days) Mean ± SD	5.2 ± 2.1	4.8 ± 1.9	0.58

The details of operative and fixation procedures are given in Table 2. A critical analysis of the table showed that the mean operative time was longer in Group A (98.6 ± 18.4 minutes) versus Group B (85.3 ± 15.7 minutes), and the p values were found to be significant. This could be because of the technical demand of posterior plating with the posterolateral approach. Similarly, the fluoroscopy time in Group A was (42.5 ± 10.2 seconds) compared to Group B (55.8 ± 12.6 seconds), showing improved visualization and better reduction obtained faster in the posterior plating group. The need for additional fixation of the medial malleolus, posterior malleolus, or syndesmosis was comparable between the two groups, and no intraoperative complications were encountered in either group. This indicates that both techniques are safe and feasible when performed appropriately using a posterolateral approach.

Table 2: Operative Details and Additional Procedures			
Parameter	**Group A (Posterior Plating)**	**Group B (Lateral Plating)**	
Mean Operative Time (Minutes)	98.6 ± 18.4	85.3 ± 15.7	
Mean Fluoroscopy Time (Seconds)	42.5 ± 10.2	55.8 ± 12.6	
Additional Fixation Required			
Medial Malleolus Fixation	4 (26.7%)	3 (20.0%)	
Posterior Malleolus Fixation	2 (13.3%)	2 (13.3%)	
Syndesmotic Screw	3 (20.0%)	5 (33.3%)	
Intra-operative Complications	0 (0%)	0 (0%)	1.000
*Significant			

Radiological and postoperative recovery parameters are presented in Table 3. Analysis of the table showed that the mean hospital stay, time to radiological union, and time to full weight-bearing were comparable, indicating similar healing profiles with no statistical differences. Radiological alignment was anatomical in 93.3% of patients in both groups, with the remaining cases achieving acceptable alignment. These findings suggest that both posterior and lateral plating provide adequate mechanical stability for fracture union.

Table 3: Radiological and Postoperative Recovery Parameters			
Outcome	**Group A (Posterior Plating)**	**Group B (Lateral Plating)**	**p-value**
Mean Hospital Stay (Days)	4.1 ± 1.2	3.8 ± 1	0.45
Time to Radiological Union (Weeks)	12.1 ± 1.5	12.6 ± 1.8	0.407
Radiological Alignment			
Anatomical	14 (93.3%)	14 (93.3%)	1.000
Acceptable (<2mm step/gap)	1 (6.7%)	1 (6.7%)	
Full Weight-Bearing (Weeks)	10.8 ± 1.2	11.2 ± 1.4	0.408

Functional outcomes at final follow-up at six months are given in Table 4. Functional assessment showed significantly better outcomes in Group A. Group A had a higher proportion of patients who achieved excellent OMAS scores in the posterior plating group (66.7%) compared to the lateral plating group (33.3%), with a statistically significant difference ($p = 0.027$). The mean OMAS score was also significantly higher in Group A (90.3 ± 8.1) than in Group B (81.6 ± 12.4), with no statistically significant difference. Similarly, the range of motion was marginally better in Group A, particularly dorsiflexion, though this did not reach statistical significance. A greater proportion of patients in Group A returned to pre-injury activity levels, further suggesting superior functional recovery with posterior plating, even though the difference was not statistically significant.

Table 4: Functional Outcomes at Final Follow-up (6 Months)			
Assessment Criteria	**Group A (Posterior Plating)**	**Group B (Lateral Plating)**	
Olerud-Molander Ankle Score (OMAS)			
Excellent (91-100)	10 (66.7%)	5 (33.3%)	
Good (61-90)	4 (26.7%)	7 (46.7%)	
Fair (31-60)	1 (6.7%)	2 (13.3%)	
poor (0-30)	0 (0%)	1 (6.7%)	
Mean OMAS Score	90.3 ± 8.1	81.6 ± 12.4	
Range of Motion (vs. Contralateral side)			
Dorsiflexion (% of normal)	96.5 ± 4.2	92.1 ± 7.8	
Plantarflexion (% of normal)	98.2 ± 3.1	96.8 ± 4.5	
Return to Pre-injury Activity	14 (93.3%)	12 (80.0%)	0.289
*Significant			

Postoperative complications are given in Table 5. Overall complication rates were significantly lower in Group A (13.3%) compared to Group B (46.7%), with significant p-values. Implant irritation and prominence were notably higher in the lateral plating group (33.3%), with none reported in the posterior plating group (p = 0.010). Therefore, the need for implant removal was significantly greater in Group B (40.0%) compared to Group A (6.7%). P-values were significant. Superficial wound infections, delayed union, and other complications were comparable between groups. The markedly lower implant-related complications in posterior plating highlight the advantage of posterior plate positioning beneath better soft-tissue cover.

Overall results showed that both posterior and lateral plating provide comparable radiological outcomes and fracture union; posterior plating through a posterolateral approach offers superior functional outcomes and significantly fewer implant-related complications. Despite a longer operative time, posterior plating appears to be a clinically advantageous technique for fixation of lateral malleolus fractures.

Table 5: Postoperative Complications

Complication	Group A (Posterior Plating)	Group B (Lateral Plating)	p-value
Overall Complications	2 (13.3%)	7 (46.7%)	0.047*
Superficial Wound Infection	1 (6.7%)	2 (13.3%)	0.548
Wound Dehiscence	0 (0%)	1 (6.7%)	0.311
Implant Irritation Prominence	0 (0%)	5 (33.3%)	0.010*
Delayed Union (>16 weeks)	1 (6.7%)	1 (6.7%)	1.000
Implant Failure / Screw Loosening	0 (0%)	0 (0%)	1.000
Need for Implant Removal	1 (6.7%)	6 (40.0%)	0.034*
Reason: Pain/Prominence	1	5	
Reason: Infection	0	1	

*Significant

DISCUSSION

The current study aimed to evaluate the outcome of lateral malleolus fractures using the posterolateral approach. The outcome profile was studied based on functional outcome, radiological union, and complication rate. The overall findings of this study demonstrated that both techniques were comparable as far as fracture union and alignment are concerned. However, posterior plating offered better functional outcomes, as fewer patients in this study group developed implant-related complications. The demographic profile of the study participants is given in Table 1. The overall table showed that both groups were found to be comparable in terms of demographic profile, strengthening the distribution profile, and minimizing confounding factors that could be related to distribution. In this study, we found Weber B fractures occurred more frequently in the cohort, which is in agreement with the pattern of ankle fractures reported in the literature [1,2]. Operative time assessment in the cases of this study showed that the posterior plating group required significantly longer operating time, probably due to the technical demand of posterior plating with posterolateral approach, which required meticulous dissection with placement of posterior antigliding plate [9,12]. However, the fluoroscopy time was lesser in this group, which indicated better visualization and mechanical control of the distal fragments. This is in line with biomechanical observations that posterior plating provides a stable anti-gliding construct [5,6]. The current study showed that there were no differences in radiological outcome among groups, and there were high rates of anatomical reduction and equal time to union. These results are consistent with biomechanical and clinical research studies that have proven that anterior plating is as stable, or more stable, than lateral plating, particularly in the oblique fracture pattern [6,13]. The fact that no implant failures were observed in either of the groups also indicates the mechanical stability of the two methods. The Olerud-Molander Ankle Score determined the functional outcomes, and these outcomes were significantly better in the anterior plating group. There was a better percentage of patients who resulted in excellent outcomes, and the OMAS score was significantly higher. A decreased implant prominence and an improved soft-tissue tolerance probably helped to increase the comfort during rehabilitation. Redfern et al. [10] in a similar study, showed that improvement in functional scores and patient satisfaction occurred with posterior fibular plating, which was attributed to decreased soft-tissue irritation in this group. Lamontagne et al. [14] also reported similar results in which they highlighted the benefits of an anterior fixation based on patients' satisfaction. Lateral plating had a higher rate of postoperative complications. The most frequent ones were implant irritation and prominence, and the implant removal rates were significantly higher. This observation is in agreement with other existing studies that show implant removal rates of 20-40% after lateral fibular plating as a result of subcutaneous implant placement [4,11,15]. Conversely, anterior plating has the advantage of a higher tissue cover on the posteriors, which is the reason the irritation rate is lower and secondary surgery is not required in any cases in the current research. The rate of infection and delayed union was low and similar in both groups, suggesting that both methods are safe when the correct technique of

surgery and handling of soft tissues are used. Lack of stability in the syndesmos or implant failure also contributes to the effectiveness of posterior plating as a reliable fixation technique [16]. As with any other research, the present study had its own strengths and limitations. The limitations of the study were due to its modest sample size and relatively short time to follow-up. Larger randomized studies with longer follow-up are required to detect long-term results and complications. In the end, this study found that posterior plating through a posterolateral approach provides superior functional outcomes with fewer implant-related complications. Therefore, it must be considered as an alternative to traditional lateral plating in appropriately selected lateral malleolus fractures.

CONCLUSION

The present study demonstrated that lateral malleolus fractures treated with posterior and lateral plating using a posterolateral approach provided comparable results with reliable fracture union and radiological outcomes. The functional outcomes were found to be superior in the posterior plating group based on higher ankle scores and significantly fewer implant-related complications. Although posterior plating requires a longer operative time, it offers better soft-tissue tolerance and reduces the need for secondary implant removal. Based on these findings, posterior plating appears to be a safe and effective alternative to lateral plating and may be used in cases of lateral malleolar fractures whenever feasible.

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