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Original Article

Operative treatment results of posterior malleolar fractures in trimalleolar fractures with screw fixation and plate fixation: short-term results

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Abstract: Background: Ankle fractures are among the most common lower limb fractures. There is no agreement about the best treatment for these fractures. This study compared the short-term results of screw and plate fixation methods. Methods: In this prospective study, 32 patients that underwent screw fixation for posterior malleolar fracture and 32 patients that underwent plate fixation for posterior malleolar fracture were assessed 1, 3, and 6 months after surgery. Results: The mean age in group 1 (screw fixation) and group 2 (plate fixation) was 32.56, and 37.82 ± 9.99, respectively. The frequency of gender in group 1 (screw fixation) and group 2 (plate fixation) for females and males was 20%, 80%, 4%, and 18%, respectively. The mean range of motion (ROM) in month 1 in group 1 was 89.4, in group 2 was 90.22, in month 3 in group 1 was 100.6, in group 2 was 100.36, in month 6 in group 1 was 115.4, and in group 2 was 110.68. The mean visual analog scale (VAS) in month 1 in group 1 was 6.88, in group 2 was 6.09, in month 3 in group 1 was 4.14, in group 2 was 3.63, in month 6 in group 1 was 2.56, and in group 2 was 2.54. In group 1, we had 1 case of nerve injury, 1 case of deep infection, and 3 cases of superficial infection, and in group 2, we had 2 cases of nerve injury, 2 cases of deep infection, and no case of superficial infection. The mean foot and ankle outcome score (FAOS) in group 1 was 75.44, and in group 2 was 74.36. Conclusion: In our study, we were unable to indicate a superior treatment method. More comprehensive studies with larger populations are suggested.

Keywords: Ankle fracture, bone plate, bone screw, posterior malleolar fracture, surgical outcome

Introduction

Epidemiology

Ankle fractures, which account for 10% of all bone injuries, have seen an upward trend in recent decades [1]. Heckman et al. in Sweden reported an annual incidence rate of 33 cases per 100,000 person-years [2], while Elsoe et al. in Denmark reported it from 20 to 40 [3]. Trimalleolar fractures are particularly prevalent in the age group of 60 to 69, with women above 60 having the highest incidence of open fractures. Seasonal variations also contribute to increased incidences. Complex ankle fractures can occur through various mechanisms, with falls from standing heights and ankle distortion being the most common cause [4-7]. Over the past decade, scientific research on ankle fracture management has improved our understanding of bone and soft tissue injuries. To achieve favorable outcomes, stability and alignment must be restored through non-surgical or surgical means. If dislocation occurs, immobilization is crucial [1-3].

Prognosis

Up to 50% of malleolar fractures involve fractures of the posterior malleolus (PM), which is the posterior margin of the distal tibia [4-7]. A less favorable outcome for ankle fractures has historically been linked to the presence of a PM fragment [7-12]. It's possible that less-than-ideal treatment outcomes following ankle fractures have been caused by earlier failures to appropriately identify and treat PM fractures.

Typical clinical features

The Bartoníček and Rammelt [13] classification was used for posterior malleolar fractures because, in contrast to other classifications, it represents a continuum of increasing injury severity [13-18], is related to the mechanism of injury [19], can be used as a treatment guide [13, 17, 20], and has been demonstrated to be relevant to prognosis [21].

Standard diagnostic

There is continuous discussion on the magnitude of a posterior malleolar fracture that needs to be fixed as well as the accuracy of measures made using plain lateral radiographs. According to a number of studies, fixation is necessary for posterior malleolar fractures covering 25-33% of the tibial plafond [22-27]. It appears senseless to rely on dubious diagnostics if the posterior fragment's size is crucial for making decisions. It has been previously noted that two-dimensional computed tomography (CT) measures have higher reliability than plain radiograph measurements [22]. Ferries' research, however, was constrained by a 2D-CT reference standard as opposed to quantification using 3D-CT [28-30]. Furthermore, a recent study found that, in contrast to their standard - the interpretation of the senior author and an experienced musculoskeletal radiologist in a consensus agreement - plain radiographs allowed for accurate assessment of the size of the posterolateral fragment in terms of interobserver reliability by eight skilled orthopaedic trauma surgeons [25]. According to many studies the goal was to compare plain lateral radiographs to a 3D-CT reference standard in order to reduce subjectivity. Articular surface area can be reliably calculated through the use of quantification of 3D-CT modeling (Q-3D-CT), according to prior studies [31-33]. Through mapping posterior malleolar fractures, the study provided insights into their characteristics. It observed a continuous spectrum of fractures from Haraguchi III to I, identifying Haraguchi II as distinct. This mapping approach allowed a comprehensive understanding of fracture types and distributions. Additionally, 3D CT modeling reliably quantified characteristics, accurately assessing fragments. This advanced imaging technique revealed precise measurements and insights. Importantly, the study highlighted morphology's significance in clinical decisions for posterior malleolar fractures. While size matters, morphology may also crucially guide treatment as revealed through mapping fracture shape and structure [34].

Treatment

The optimal way to treat PM fractures is still up for discussion despite a growing corpus of research [35-37]. For a number of years, the requirements for surgically fixing a PM fragment were as follows: the fragment had to be between 1/4 and 1/3 of the articular surface, and it had to be displaced more than 2 mm on the lateral radiograph [38-41]. In addition to size and displacement, involvement of the incisura, the presence of intercalary fragments, plafond impaction, and syndesmotic instability are increasingly taken into consideration for decision-making with the increased use of CT imaging and understanding of the three-dimensional pathoanatomy of PM fractures [13, 18, 36, 37, 42-44]. The management of ankle fractures, whether through conservative or surgical means, is contingent upon the type of fracture and the recommendations put forth by the surgeon. The debate regarding the preferred approach, surgical or conservative, persists within the medical community, with no definitive solution currently available in the literature [45]. Treatment must thus be customized for each unique three-dimensional fracture pattern. The objectives of surgical fixation have changed in recent years to include the following: (1) Bone-to-bone fixation of the posterior tibiofibular ligament; (2) Restoration of articular congruity at the distal tibia and posterior containment of the talus; and (3) Restoration of the fibular notch, which facilitates reduction of the distal fibula [13, 17, 36]. The outcomes of trimalleolar fractures are determined by five key factors: size of PM fragment, anatomic reduction of articular surface, syndesmotic stability, surgical approach, and fixation technique. Optimizing these factors ensures optimal treatment for challenging injuries [46]. In terms of clinical treatment, posterior malleolar fractures can be addressed through either a direct posterolateral or posteromedial approach. In these approaches, the reduction is upheld through posteroanterior (PA) lag screws or posterior buttress plate fixation. Alternatively, an indirect anterior approach can be employed, utilizing subcutaneous anterior-to-posterior (AP) lag screws fixation [47, 48]. The primary objective of these surgical procedures is to swiftly establish stability and restore anatomical integrity, thereby facilitating earlier joint mobility. However, it is important to acknowledge the inherent possibility of complications arising from these procedures. Such complications may encompass wound infection, embolism, compromised stability, the necessity of reoperation, and even the potential requirement for amputation [49, 50].

Our study sought to assess and juxtapose the treatment outcomes of patients with posterior malleolar fractures who underwent surgical intervention employing either plate or screw fixation.

Methods

Study design

This was a prospective study. This study encompassed patients who received treatment for posterior ankle fractures at Kashani Hospital in Isfahan within the timeframe spanning 2021 to 2022. Rest assured, this project obtained the necessary approval from the esteemed Ethics Committee of Isfahan University of Medical Sciences, with the designated code IR.MUI.MED.REC.1400.465. Moreover, informed consent was diligently acquired from all participating patients.

Inclusion and exclusion criteria

Individuals who met the inclusion criteria for this study were those who experienced posterior ankle fractures with simultaneous involvement of the medial, lateral, and posterior malleoli, specifically with posterior malleolar fractures encompassing more than 25% of the articular surface. These individuals willingly underwent surgical intervention utilizing either screw or plate fixation and provided informed consent to participate in the study. Conversely, individuals with syndesmosis injury, underlying ailments that could potentially impact ankle joint function and consequently influence the study's outcomes (such as neurovascular diseases like diabetes), syndesmosis fractures, previous fractures in the same region or similar lower limb, and patients with soft tissue swelling and syndesmosis injury, were excluded from the study.

Data collection

In this study, a total of 64 patients who presented at Kashani Educational Center between 2021 and 2022 with posterior ankle fractures involving three malleolar fractures were included. Among them, 25 patients were assigned to the screw fixation group (group 1), while 22 patients were allocated to the plate fixation group (group 2), resulting in a total of 47 participants who completed the study.

To assess and compare the treatment outcomes, all patients underwent X-ray evaluations at one, three, and six months postoperatively. Additionally, at these respective time points, a skilled orthopedic specialist conducted thorough examinations of each patient. The evaluation encompassed various aspects, including joint range of motion, pain levels measured using the Vas score questionnaire, presence of plantar fasciitis, Achilles tendinosis, and ankle instability evaluated through the FAOS questionnaire.

To quantify the severity of pain experienced by the patients, a visual analog scale (VAS) was employed. The VAS score ranges from 1 to 10, with 1 indicating the absence of pain and 10 representing the highest degree of excruciating and unbearable suffering. This rapid, straightforward, fluent, and reliable pain assessment tool has been widely used in numerous studies and medical settings, proving its efficacy and validity.

The Foot and Ankle Outcome Score (FAOS) has proven to be a valuable tool in assessing the patient's perception of various foot and ankle-related concerns. Its effectiveness has been demonstrated in patients with conditions such as plantar fasciitis, Achilles tendinosis, and ankle instability. The validity of FAOS content was verified by a cohort of 213 patients with ankle instability.

FAOS comprises five distinct subscales, namely pain, other symptoms, daily living (ADL), sport and recreation (Sport (Rec)), and foot and ankle-related quality of life (QOL). Each subscale consists of standardized response options presented as percentage Likert boxes, with a numerical score ranging from 0 to 4 assigned to each question. The normalized values for each subscale range from 0 (indicating the absence of symptoms) to 100 (indicating severe symptoms). By utilizing these scores, an outcome profile can be constructed, effectively representing the result.

One of the notable characteristics of FAOS is that it is a patient-administered assessment, designed in a user-friendly format that can be completed in approximately 10 minutes. This straightforward test can be easily administered to individuals aged between 20 and 60, either in the waiting room or via mail, further enhancing its convenience and accessibility [51].

In strict adherence to the principle of confidentiality, the gathered data was meticulously recorded in the research checklist, ensuring the utmost protection of privacy and maintaining the confidentiality of the participants' information.

Interventions

The data of all patients that met the inclusion criteria entered the study using the census method. After receiving written valid consent, medically fit patients were taken up for using their files and for following up according to the method of the study. Procedures were performed by experienced surgeons in ankle surgery with the assistance of surgical residents. Antibiotic prophylaxis was performed according to hospital protocol. All patients were operated under spinal anesthesia and pneumatic tourniquet. The surgical approaches differed in those two groups. The approach and the type of fixation are related treatment decisions. The percutaneous AP approach involves screw fixation, whereas the posterolateral approach most frequently concerns open reduction and plate fixation.

Group 1: After fixation of the medial and lateral malleolus, the posterior malleolus was fixed with cannulated lag screws placed in the anterior to the posterior direction in the supine position. After prep and drapes were in supine positions, with medial incision, medial malleole was fixed, then with lateral incision, lateral malleolar was fixed with 1/3 tubular plate or intramedullary pin and checked with C arm. If reduction of posterior malleolar was accepted, it was fixed with cannulated screw from anterior to posterior with separate anterior incision.

Group 2: After prep and drapes were in prone positions and fixation of medial malleule, a longitudinal cut of the skin was made between the posterior fibulary margin and the lateral boundary of the tendon achalis [36, 52-54]. The sural nerve has been identified and protected. Superficial dissection was performed directly by developing the plane between the peronei and the tendon achalis. A blurry dissection was performed between the intermuscular septum between the lateral muscles and the long spinal flexor hallucis to avoid a sural nerve injury. Afterwards, the flexor hallucis longus muscle was lifted from the posterior tibia and interosseous membrane, exposed to the posterior malleolus fragment, and the PITFL soft tissue attachment to the medial malleolus and joint capsules was carefully handled. The fragment is usually triangular and its top is above and was exposed from mid-lateral to side for joint inspection. Reducing fragments of the original foot prints ensures its perfect reduction, since you cannot properly see the joint. Sometimes fibulary fractures are initially exposed reduced but not fixed, which helps to reduce the posterior malleolus. The fibroblast fracture is not fixed first, but reduces, as the metal plate obscures the radiological control of the reduction of the posterior malleolus fracture. Once the rear malleolus has been reduced, it should be temporarily fixed by two "K" wires and confirmed by an image intensifier. Subsequently, the posterior malleolus is fixed by small fragment-T plate. After the fixation of the posterior malleolus, the fibula is fixed by the same cutting by the standard plate fixation technique or, if the fracture is transverse, the rush nail can be stabilized. Finally, the syndesmosis is checked to ensure the stability that is achieved because the PITFL is stabilized by the posterior fixation of the malleolus [55].

Postoperative follow-up

Following surgery, both groups received oral antibiotics and analgesics. At two weeks, the sutures were taken out. In the first week following surgery, crepe bandages were applied to both groups. On day 2, the mobilization program commenced. To lessen postoperative edema, patients were told to elevate their feet. They were also taught self-assisted active and passive exercises for all of the joints in their feet, which they originally performed under observation. For the first four weeks, patients

Figure 1. Anteroposterior view of plate fixation.

Figure 2. Lateral view of plate fixation.

underwent vigorous physical therapy and were taught isotonic and isometric exercises. The range of motion of the ankle and VAS score were assessed one, three, and six months after surgery, and FAOS was compared between the two groups.

Statistical analysis

The obtained data were analyzed using the Statistical Package for Social Sciences (SPSS) software (version 24.0; SPSS Inc., Chicago, IL, USA). Demographic and clinical characteristics of patients were reported as frequency (percentage) for qualitative variables and mean ± standard deviation (SD) for quantitative variables. Qualitative variables between the study groups were compared using the Chi-squared test and Fisher's exact test. The normality of distribution in quantitative variables was assessed using the Kolmogorov-Smirnov test. Normally and non-normally distributed quantitative variables were compared between the study groups using the independent T-test and Mann-Whitney U-test, respectively. The association of Operative treatment results of posterior malleolar fractures in trimalleolar fractures with screw fixation and plate fixation was investigated using logistic regression in crude and adjusted models. Odds ratio (OR) and 95% confidence (95% CI for OR) were reported. *P*-value < 0.05 was considered as the significance threshold in all analyses.

Results

Upon completion of the sampling process, a total of 32 patients were successfully enrolled in each group. In group 1, which underwent screw fixation (**Figures 3**, **4**), there were 25 patients, while group 2, which underwent plate fixation (**Figures 1**, **2**), consisted of 22 patients. In group 1, there were 20 male and 5 female participants, with a mean age of 32.56. Similarly, in group 2, there were 18 male and 4 female participants, with a mean age of 37.81.

Furthermore, as indicated by the results in **Table 1**, there was no statistically significant difference observed in terms of mean age and gender distribution between the two study groups (P > 0.05).

As shown in **Table 2**, the mean ROM in the first month was (89.94 ± 5.06) in group 1 and (90.22 ± 8.08) in group 2, with a statistically significant difference observed (P = 0.014). However, the mean ROM in the third month (100.6 ± 6.34 in group 1 vs. 100.36 ± 8.31 in group 2) and sixth month (115.4 ± 7.48 in group 1 vs. 110.68 ± 8.2 in group 2) showed no statistically significant differences (both P > 0.05).

Regarding the mean VAS scores, there were no statistically significant differences observed between the two groups in the first month (6.88 ± 0.92 in group 1 vs. 6.09 ± 0.61 in group 2), third month (4.14 ± 0.98 in group 1 vs. 3.63 ±

Figure 3. Anteroposterior view of screw fixation.

Figure 4. Lateral view of screw fixation.

0.84 in group 2), and sixth month (2.56 ± 0.76 in group 1 vs. 2.54 ± 0.73 in group 2) (all $P > 0.05$) (**Table 3**).

The occurrence of complications in the study groups is as follows: in group 1, there was one case of nerve injury involving the sural nerve, one case of deep infection, and three cases of superficial infection. On the other hand, in group 2, there were two cases of nerve injury (sural nerve) and two cases of deep infection. Notably, no instances of malunion or nonunion were observed throughout the entirety of our study.

Regarding the mean Foot and Ankle Outcome Score (FAOS), it was found to be 75.44 ± 5.01 in group 1 and 74.36 ± 4.64 in group 2 (*P* value = 0.591, **Table 2**).

Discussion

In a considerable percentage ranging from 7% to 44% of rotational ankle fractures, it is common to observe a fracture involving the posterior malleolus. When the fracture affects more than 25% of the articular surface, the established treatment approach has traditionally involved surgical fixation [7, 56].

Several studies have consistently shown that ankle fractures that involve the posterior malleolus tend to have a poorer prognosis. However, due to the absence of a standardized approach for evaluating the functional outcomes of treatment, it remains a subject of ongoing debate regarding the appropriate management and indications for repairing these fractures. The lack of a uniform assessment method complicates the comparison of results, further fueling the discussions surrounding this matter [29].

Typically, correction of posterior malleolar fragments involves two main approaches: the posterolateral (PL) route utilizing screws and/or a buttress plate, or percutaneous anterior to posterior (AP) screws. The PL approach enables direct reduction of the fracture by utilizing screws and/or a buttress plate. On the other hand, AP screw fixation relies on the reduction of the posterior malleolus through ligamentotaxis of the posterior inferior tibiofibular ligament, along with the reduction of the fibula. It is important to note that a posterior malleolar fragment is considered an AO type B articular damage. In the majority of cases, buttress plating is the preferred method for treating AO type B injuries in other regions, as opposed to screw fixation from the opposing side. This information highlights the different approaches commonly employed for correcting posterior malleolar fragments, taking into account the specific characteristics of the fracture and the principles of fracture reduction and fixation [57].

Typically, the correction of posterior malleolar fragments involves two main approaches: the posterolateral (PL) route utilizing screws and/

Table 1. Demographic data

		Group 1 N = 25	Group 2 N = 22	*p*-value
Age (mean ± SD)		32.56 ± 8.81	37.81 ± 9.99	0.61
Gender N (%)	Female	5 (20.00%)	4 (18.18%)	0.99
	Male	20 (80.00%)	18 (81.82%)	

or a buttress plate, or the percutaneous anterior-to-posterior (AP) screws. The PL approach allows for direct reduction of the fracture, while fixation with 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. It is worth noting that a posterior malleolar fragment is considered an AO type B articular damage. In most cases, the preferred method for treating AO type B injuries in other regions is buttress plating, as opposed to screw fixation from the opposing side. However, in certain instances, the less common posteromedial technique may be employed. This technique offers the advantage of effectively treating a substantial posterior malleolar fracture, particularly in cases with medial extension. A recent study conducted by Zbeda et al. involved 22 surgeries aiming to anatomically reduce and fix the posterior malleolar fracture with a plate, utilizing the posteromedial approach. The study reported complications including one case of nonunion, one case of cellulitis, one case of osteomyelitis involving the fibula, and one case of symptomatic heterotopic ossification. Notably, the results demonstrated complete healing in all patients except for one. This information provides insights into the various surgical approaches used to address posterior malleolar fractures, highlighting the advantages and considerations associated with each technique. Additionally, it references a recent study conducted by Zbeda et al. that sheds light on their experience and outcomes in treating posterior malleolar fractures using the posteromedial approach [58].

Upon retrospectively examining a group of 48 patients who underwent open reduction and internal fixation (ORIF) for trimalleolar fractures, researchers conducted a comparative study to assess the effectiveness of two different methods. The average follow-up time for all patients was 21.1 months (ranging from 15 to 54 months). Notably, none of the patients experienced nonunion or delayed union, and all patients achieved functional bone healing within an average of 10.7 weeks (ranging from 8 to 16 weeks). The researchers evaluated the outcomes using the American Orthopedic Foot and Ankle Society (AOFAS) scores at 6 months, 12 months, and the final follow-up. In the posteromedial (PM) group, the mean AOFAS scores were 91.4 (ranging from 82 to 100), 92.5 (ranging from 84 to 100), and 92.9 (ranging from 86 to 100), respectively. Similarly, in the posterolateral (PL) group, the mean AOFAS scores were 89.9 (ranging from 72 to 100), 91.4 (ranging from 77 to 100), and 91.9 (ranging from 77 to 100), respectively. The study also examined the range of motion (ROM) losses in dorsiflexion and plantarflexion at the end of the study. The median ROM loss for dorsiflexion was 0° (ranging from 0° to 5°), while there was no median loss observed for plantarflexion (0°, 0°). Importantly, no significant differences were found between the two techniques regarding AOFAS scores and ankle ROM at each postoperative phase. Based on these findings, the researchers concluded that both methods of fixing the posterior malleolus yielded satisfactory results and demonstrated comparable clinical and radiological outcomes [59].

The study conducted by Huber et al. aimed to compare the quality of reduction of the posterior tibial malleolus in ankle fracture dislocations with the involvement of the posterior malleolus. The study included 30 consecutive cases treated with recommended techniques (group I) and a study group consisting of 30 consecutive similar fracture-dislocations treated with a single posterolateral approach, direct open reduction, and dorsal anti-glide plate fixation of the fibula and tibia (group II). The results of the study revealed that in group I, 8 out of 30 cases (27%) achieved anatomical reductions, whereas in group II, 25 out of 30 cases (83%) achieved anatomical reductions. This difference was found to be statistically significant. Additionally, 4 patients in group I and 1 patient in group II had articular mal-reductions of 1 mm, while 7 cases in group I and 1 case in group II had articular mal-reductions of 2 mm. Furthermore, 5 cases in group I and 2 cases in group II had articular mal-reductions exceeding 2 mm. In 6 instances in group I, the reduction evaluation was hindered due to radiological superimposition caused by the fibular plate.

Table 2. The mean results of the study findings

	VAS 1	VAS 3	VAS 6	ROM 1	ROM 3	ROM 6	FAOS
Group 1	6.88 ± 0.92	4.14 ± 0.98	2.56 ± 0.76	89.94 ± 5.06	100.6 ± 6.34	115.4 ± 7.48	75.44 ± 5.01
Group 2	6.09 ± 0.61	3.63 ± 0.84	2.54 ± 0.73	90.22 ± 8.08	100.36 ± 8.31	110.68 ± 8.2	74.36 ± 4.64
P value	0.09	0.431	0.507	0.014	0.999	0.626	0.591

ROM: range of motion. VAS: visual analog scale.

Table 3. Intergroup analysis of findings using Chi-Square test

	ROM 1 vs. 3 *p*-value	ROM 1 vs. 6 *p*-value	ROM 3 vs. 6 *p*-value	VAS 1 vs. 3 *p*-value	VAS 1 vs. 6 *p*-value	VAS 3 vs. 6 *p*-value
Group 1	0.002	0.004	0.041	0.41	0.225	0.001
Group 2	0.138	0.012	0.016	0.302	0.192	0.11

Notably, in 2 cases of group II, the sagittal diameter of the distal articular surface of the tibia could not be anatomically repaired due to insufficient posteroanterior compression resulting from the proximal positioning of the plate. Throughout the study, all patients were closely monitored until the radiological union was achieved, and they were able to bear full weight and return to unrestricted activity [60].

In a separate study conducted by O'Connor, involving sixteen patients who underwent posterior buttress plating and eleven patients who received AP screw fixation for trimalleolar ankle fractures, the mean follow-up durations were 54.9 and 32 months, respectively. The demographic characteristics of the patients were comparable between the two groups. The study observed statistically significant differences in the Short Musculoskeletal Function Assessment (SMFA) scores, specifically the bother index, between the posterolateral plating group and the AP screw group (26.7 vs. 9.2, P = 0.03). Additionally, there were trends indicating improvement in mobility (28.3 vs. 12.9, P = 0.08) and functional indices (20.2 vs. 9.4, P = 0.08) in the posterolateral plating group. Regarding the range of motion and the progression of ankle arthritis, no significant variations were observed over time in either group. Based on these findings, the researchers concluded that patients with trimalleolar ankle fractures who underwent posterolateral buttress plating for the posterior malleolus achieved better clinical outcomes during follow-up compared to those who received AP screws. This study contributes valuable insights into the comparative effectiveness of different surgical approaches for trimalleolar ankle fractures, specifically highlighting the advantages of posterolateral buttress plating in terms of postoperative SMFA scores and clinical improvements [61].

Our study, despite its valuable findings, is not without limitations. The most notable limitation is the small size of our population, which may impact the generalizability of our results. Thus, we recommend conducting more extensive and comprehensive studies to further explore and establish the optimal surgical treatment approaches for posterior malleolar fractures.

By addressing this limitation, future research endeavors can provide a more robust and reliable understanding of the most effective and suitable surgical interventions for this specific type of fracture. Expanding the scope of the investigation will facilitate evidence-based decision-making and enhance clinical practices in the management of posterior malleolar fractures.

Conclusion

In our study, we conducted a comparison of plate and screw fixation for the treatment of posterior malleolar fractures, focusing on short-term outcomes. Regrettably, we were unable to identify a superior treatment method based on our findings. However, it is important to acknowledge that our study had certain limitations, particularly the small size of the population under investigation.

To further advance our understanding and provide more conclusive evidence, we recommend conducting more comprehensive studies with larger populations. By expanding the scope of research, we can obtain a more comprehensive and accurate picture of the efficacy and outcomes associated with different treatment approaches for posterior malleolar fractures.

Through these future endeavors, we hope to shed more light on this subject and contribute to the development of improved treatment strategies that can enhance patient outcomes and guide clinical decision-making.

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Written informed consent was obtained from the patients.

Disclosure of conflict of interest

None.

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