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ORIGINAL ARTICLE

Early Mobilization is Better? Comparison of isolated Non-Displaced Medial Malleolus Fracture treated with pop Cast Versus Malleolar Screw Fixation

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ABSTRACT

Introduction: Medial malleolar fractures are among the most commonly encountered injuries in clinical practice. Plaster of Paris casting is commonly used for undisplaced fractures, while multiple surgical fixation techniques for closed reduction have been described, including Kirschner wires, cancellous screws, tension band wiring, and their modifications.

Objective: The objective of this study is to compare POP cast versus Single screw fixation for medial malleolus fracture of the foot.

Materials and Methods: This single-blinded randomized controlled trial was conducted at the Department of Orthopedic Surgery, King Edward Medical University, Mayo Hospital Lahore, from October 2022, to April 2023. Using a non-probability consecutive sampling technique, 314 patients aged 15–60 years with closed, isolated medial malleolus fractures were enrolled, while patients with open or pathological fractures were excluded. Participants were randomly allocated into two groups using a lottery method. Group I was managed conservatively with fracture reduction followed by Plaster of Paris cast application, while Group II underwent percutaneous malleolar screw fixation. Fracture reduction in both groups was confirmed using an image intensifier. Functional outcome was assessed at the 16th postoperative week according to the operational definition of the study.

Results: The mean age was 36.82 ± 13.65 years in Group A (POP cast) and 36.72 ± 14.11 years in Group B (screw fixation), with a range of 15–60 years in both groups. Group A comprised 30 males (63.82%) and 17 females (36.17%), while Group B included 26 males (55.31%) and 21 females (44.68%). Good to excellent outcomes were observed in 36 cases (76.59%) in Group A and 41 cases (87.23%) in Group B, whereas 10 (21%) and 6 (12.76%) cases, respectively, did not achieve good to excellent outcomes. Group B demonstrated a statistically significant difference in the functional outcomes compared to Group A ($p < 0.05$).

Conclusion: Malleolar screw fixation showed statistically significant difference in functional outcomes in patients with medial malleolus fractures of the lower limbs. This technique may be considered to enhance functional recovery and reduce the risk of severe impairment.

Keywords: Foot fracture, medial malleolus fractures, malleolar screw fixation, functional outcome, Olerud and Molander

INTRODUCTION

Medial malleolar fractures are among the most commonly observed injuries in routine orthopedic practice by healthcare professionals and hold considerable importance due to their direct impact on ankle anatomy, functional mobility, and overall patient recovery. These fractures typically take place at a mean age of approximately 45 years, with an incidence rate of 174 per 100,000 individuals, accounting for nearly 9% of all fracture types across the globe[1,2]. Traditionally, the medial malleolus was considered as the primary stabilizing structure of the ankle joint in humans and despite its important role in maintaining ankle stability and alignment, the optimal management strategy for medial malleolar fractures remains a subject of ongoing debate.

Treatment decisions for the knee fractures largely depend on whether the fracture appears in isolation or as part of a more complex injury pattern, for example the bimalleolar or trimalleolar fractures due to a number of reasons. Although surgical intervention is linked with inherent morbidity, current scientific evidence suggests that nonoperative management of adequately reduced fractures may yield outcomes and functional mobility comparable to those achieved with surgical treatment. A detailed understanding of ankle anatomy and evolving scientific evidence regarding knee fracture management continues to model clinical decision-making among healthcare professionals and surgeons.

Plaster of Paris (POP) casting remains a widely recognized method among healthcare professionals for managing undisplaced medial malleolar fractures[2,3], whereas fractures displaced by more than 2 mm generally require surgical intervention by skilled surgeons [3]. The scientific and medical literature has described a variety of surgical fixation techniques aimed at achieving stable fracture reduction, including fixation using two parallel Kirschner wires, dual parallel cancellous screws, open reduction and internal fixation with cancellous screws, tension band wiring, and modified tension band wiring. Each technique offers distinct advantages and limitations. Open surgical approaches are commonly employed for medial malleolar fractures[4]; however, they are associated with higher rates of operative functional morbidity, postoperative pain, wound-related complications, and the potential need for secondary procedures for hardware removal when compared with percutaneous techniques. On the contrary, minimally invasive approaches are limited by reduced visualization of the fracture site by the operative surgeon[5,6].

Recent scientific and medical evidence has indicated that partially threaded bicortical screw fixation in the tibial metaphysis can offer superior biomechanical stability, improved radiological alignment, and better clinical outcomes[7]. Although conventional malleolar screw fixation offers robust mechanical support, but patients may experience complications including but not limited to hardware irritation at the tension band site and the necessity for implant removal[8,9]. Consequently, the management of medial malleolar fractures remains challenging, influenced by fracture characteristics, the functional demands of the ankle joint, and biomechanical forces affecting the articular surface following injury.

Using the modified Olerud and Molander ankle scoring system, a recent study reported excellent to good outcomes in 90% of patients treated with cancellous screw fixation compared with 80% of those managed with POP casting, with a statistically significant difference ($p = 0.049$)[10]. The present study aims to compare cancellous screw fixation with POP cast treatment for medial malleolar fractures in our local population. As no such study

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has been conducted in this community to date, evidence from other regions suggests that percutaneous screw fixation is associated with very good to excellent functional outcomes.

METHODOLOGY

Study Design and Duration: This was a single-blinded, randomized controlled trial (RCT) conducted at the Department of Orthopedic Surgery, King Edward Medical University, Mayo Hospital Lahore, from October 2022 to April 2023.

Ethical Considerations: The study was initiated after approval from the institutional ethical committee. Written informed consent was obtained from all participants or their attendants prior to enrollment. Demographic data, including age, gender, and contact information, were recorded.

Sample Size and Sampling Technique: The sample size was calculated based on previously reported rates of excellent and good outcomes, estimated at 80% in the screw fixation group and 90% in the tension-band wiring group [7]. A 95% confidence level and 80% statistical power were applied for sample size determination. A non-probability consecutive sampling technique was used for participant recruitment.

Participants: A total of 314 patients, aged 15 to 60 years, with closed, isolated medial malleolus fractures were included. Patients presenting with open fractures or pathological fractures were excluded from the study.

Baseline Assessment: Preoperative evaluation included assessment of general health status and a detailed neurovascular examination of the affected lower limb. Radiological assessment of the ankle was performed using anteroposterior, mortise, and lateral views.

Randomization and Allocation: Participants were randomly assigned into two groups i.e. Group I and Group II using a lottery method. Group I received conservative treatment, while Group II underwent surgical intervention.

Interventions: Participants in Group I underwent fracture reduction followed by application of a Plaster of Paris (POP) cast, with reduction confirmed using an image intensifier[11]. Participants in Group II were treated with percutaneous malleolar screw fixation. Fracture reduction was confirmed using an image intensifier prior to screw insertion[12]. All surgical procedures were performed under general anesthesia, following standard skin preparation and draping, an anteromedial incision was made, starting approximately 2 cm proximal to the fracture line and extending distally and slightly posteriorly to 2 cm distal to the fracture site[13,14]. Postoperatively, the ankle was elevated and immobilized in a neutral position using a posterior plaster splint[15].

Outcome Assessment: Postoperative radiographic evaluation included anteroposterior, lateral, and mortise views of the ankle. Furthermore, functional outcome was assessed at the 16th postoperative week.

Data Collection: All study data were collected and recorded by the principal investigator by using standard medical tools.

RESULTS

In group-A there were 30(63.82%) male and 17(36.17%) female cases while in group-B there were 26(55.31%) male and 21(44.68%) female participants. The mean age in group-A (POP cast) was 36.82 ± 13.65 years and in group B (Percutaneous malleolar Screw) was 36.72 ± 14.11 years. The minimum and maximum age in both groups was 15 and 60 years.

The mean weight, height, and BMI in group A was 81.01 ± 17.35 kg, 1.66 ± 0.26, and 29.68 ± 4.19 while in group B was 80.96 ± 17.04 kg, 1.65 ± 0.25 m and 29.82 ± 3.97. The mean baseline score in group A and group B was 43.85 ± 12.53 and 45.45 ± 11.92 while at follow the mean score in group A and group B was 83.48 ± 11.75 and 87.92 ± 6.87 respectively.

In group A there were 36(76.59%) cases that had good to excellent outcomes and 10(21%) had not good to excellent outcomes while in group B there were 41(87.23%) who had good to excellent outcomes and 6(12.76%) cases did not have good to excellent outcome.

When data was stratified for age, gender, BMI, and baseline score the good to excellent scores were higher in group B than group A, p-value < 0.05.

Table 1: Descriptive statistics of baseline and follow-scores in both groups

	Study groups	Mean	S.D	Minimum	Maximum
Baseline score	Group-A (n=47)	43.85	12.53	24.00	70.00
	Group B (n=47)	45.45	11.92	24.00	78.00
	Total (n=94)	44.65	12.23	24.00	78.00
Score at follow-up	Group-A (n=47)	83.48	11.75	46.00	100.00
	Group B (n=47)	87.92	6.87	71.00	100.00
	Total (n=94)	85.70	9.86	46.00	100.00

Table 2: Comparison of scores in both groups

		Study groups		Total
		Group-A	Group-B	
Good to excellent	Yes	36 (76.59%)	41 (87.23%)	77 (81.91%)
	No	10 (21%)	6 (12.76%)	17 (18%)
Total		47 (100%)	47 (100%)	94 (100%)

DISCUSSION

The ankle joint is formed by the articulation of the talus with the distal tibia and fibula, creating a saddle-shaped configuration that relies on both osseous and ligamentous integrity for stability. Maintenance of ankle stability requires an intact distal tibiofibular syndesmosis along with the medial and lateral osseo-ligamentous complexes and the medial malleolar osteoligamentous complex comprises the medial malleolus and the superficial and deep components of the deltoid ligament[16]. The deep deltoid ligament, oriented more transversely, plays a key role in limiting external rotation of the talus, whereas the superficial deltoid ligament primarily resists eversion of the hindfoot. Anatomically, the superficial deltoid originates from the anterior colliculus of the medial malleolus, while the deeper deltoid arises from the larger and more posteriorly extending posterior colliculus. However, a comprehensive understanding of this anatomy is fundamental, as isolated injury to the anterior colliculus may possibly not fully compromise ankle stability[17,18].In adult patients, medial malleolar fractures are generally associated with ligamentous disruptions developing from talar subluxation or dislocation within the ankle mortise[19]. Clinically, these injuries may be reported to a healthcare provider as isolated medial malleolar fractures, bimalleolar fractures, or trimalleolar fractures involving the posterior malleolus among patients[19,20].

Dependent upon the mechanism and severity of injury, such fractures are categorized as simple, compound, or comminuted. Ankle fractures have been recognized since ancient artifact, with healed fractures identified in ancient Egyptian mummies[21]. Historical narratives by Hippocrates in the fifth century B.C. also illustrate ankle fractures, for which he suggested careful reduction by using traction and extension techniques in less severe cases[22,23]. Developments in orthopedic surgery have considerably influenced the management of medial malleolar fractures and use of hook plates by Zuelzar for avulsion fractures of the medial malleolus marked a shift toward open reduction and internal fixation. Modern knee fracture management strategies increasingly promote and favors early mobilization supported by stable internal fixation, with marginal or no persistent plaster immobilization, following in reduced morbidity and improved functional recovery[24].

Functional outcomes as observed by the current study were significantly better in group B, which received percutaneous screw fixation, compared with the POP cast group, with a p-value of less than 0.05. These findings are consistent with previous investigations. Using the modified Olerud and Molander ankle scoring system, earlier studies have reported excellent and good outcomes in 90% of patients treated with screw fixation compared

with 80% of those managed conservatively with POP casting, with a statistically significant difference (p = 0.049)[25,26].

Comparable results have also been observed in a cross-sectional study comparing tension band wiring and malleolar screw fixation for displaced closed medial malleolus fractures[26,27,28]. In that study, twenty patients treated with open reduction and internal fixation using either malleolar screws or tension band wiring were equally allocated between the two groups and managed at Al-Yarmouk Teaching Hospital between April 2012 and June 2013[29,30]. Patients were followed at regular intervals, including 10 to 14 days, six weeks, three months, six months, and one year postoperatively.

At each follow-up visit, physical and radiological assessments were performed using a structured questionnaire. The investigators reported no significant differences between the two groups in terms of age, gender, fracture type, or etiology[31]. The mean time to radiographic union was 11.8 weeks in group I and 9.4 weeks in group II, with this difference reaching statistical significance (p = 0.03). In line with the present study, good to excellent outcomes were observed in 76.59% of patients in group A and 87.23% of patients in group B, while poorer outcomes were more frequent in the conservatively managed group (p = 0.049)[32]. Analysis of complications revealed no significant differences between treatment groups, except for delayed union, which occurred more frequently among patients managed with POP casting.

The study was a randomized controlled trial as a standard procedure for clinical intervention evaluation, with blinding and a clearly defined protocol for the intervention and conducted at a tertiary level healthcare facility catering for patients across the Punjab province marks strengths of the study. However, limited sample size, duration, single blinding and limited generalizability remains limitation of the study.

CONCLUSION

The findings of this study demonstrate that, in patients with medial malleolus fractures of the foot, the proportion of good to excellent functional outcomes was significantly higher in the group treated with cancellous screw fixation compared with those managed using a Plaster of Paris cast alone. These results confirm the study hypothesis. The use of cancellous screw fixation may therefore be considered a favorable treatment approach, as it offers the potential to reduce the risk of severe functional impairment and to achieve improved functional outcomes, likely attributable to the opportunity for earlier mobilization associated with this technique.

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