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UNICORTICAL PARTIALLY THREADED LAG SCREWS VERSUS BICORTICAL FULLY THREADED LAG SCREWS FIXATION OF MEDIAL MALLEOLAR FRACTURES

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ABSTRACT

Background: Medial malleolar fractures are a common subset of ankle fractures, frequently resulting from twisting injuries. These fractures range in severity, with simple fractures often managed nonoperatively, while more complex cases require surgical intervention. Various fixation techniques are employed, depending on the fracture pattern and bone quality. The aim of study is to compare the clinical and radiological outcomes of medial malleolar fracture fixation using bicortical fully threaded lag screws versus partially threaded malleolar lag screws. **Patients and Methods:** This randomized controlled trial was conducted to compare two methods of screw fixation in medial malleolar fractures. A total of 22 patients diagnosed with isolated medial malleolar fractures and admitted for surgical treatment were included in the study. They were randomly allocated into two groups. Group I consisted of 11 patients treated with unicortical partially threaded lag screws, while Group II included 11 patients who received bicortical fully threaded lag screws. **Results:** In Group I, 24% of patients (n=3) experienced complications, specifically screw loosening and nonunion, suggesting inadequate stability with the unicortical partially threaded screw fixation. In contrast, Group II, treated with bicortical fully threaded screws, showed no such complications (0%), indicating superior mechanical stability and improved bone healing outcomes. **Conclusion:** Fixation using bicortical fully threaded lag screws demonstrated significantly better radiological and clinical results compared to unicortical partially threaded screws in the treatment of medial malleolar fractures. This technique appears to provide enhanced fracture stability and should be considered the preferred method in surgical fixation of these fractures.

KEYWORDS: Medial malleolar, malleolar screw, cortical screw.

INTRODUCTION

Medial malleolar fractures, a component of ankle fractures, are frequently encountered in clinical orthopedic practice, typically resulting from twisting or rotational injuries. These injuries are of particular clinical importance due to their functional impact and potential complications if not managed appropriately. The ankle is a diarthrodial joint that functions biomechanically as a hinge. It comprises the mortise—formed by the distal ends of the tibia and fibula, and the medial and lateral malleoli—into which the talus fits snugly, providing a high degree of inherent bony stability.[1] The talus, being wider anteriorly, contributes to the ankle's increased mechanical stability in dorsiflexion, resisting torque and shear forces more effectively in this position. The axis of rotation passes obliquely from the distal tip of the medial malleolus to the lateral malleolus, giving the ankle joint a slight external rotation in reference to the knee in the transverse plane.[1] The anatomical complexity of the ankle, especially the medial malleolar region, involves not only bone but also essential ligamentous structures. The deltoid ligament complex, including both deep and superficial components, stabilizes the medial ankle and counters external rotational forces on the talus.[1] Additionally, the lateral ligament complex, including the anterior and posterior talofibular and calcaneofibular ligaments, contributes to joint stability.[1] The integrity of these ligaments is crucial in the pathomechanics and classification of ankle fractures. Ankle fractures account for approximately 9% of all fractures, with a notable bimodal age distribution—being common in young males and elderly females. Over the past three decades, the incidence in elderly females has tripled, possibly due

to factors such as increased longevity and osteoporosis.[2–4] Several classification systems aid in understanding the mechanisms and guiding treatment strategies. The Lauge-Hansen system categorizes fractures based on foot position and the direction of the applied force (e.g., supination-adduction, supination-external rotation, pronation-abduction, and pronation-external rotation).[5] Alternatively, the Denis-Weber classification system categorizes fibular fractures by their relation to the syndesmosis (types A, B, and C), which has implications for ankle stability.[6] Medial malleolar fracture patterns vary and include avulsion, transverse, oblique, vertical, and comminuted types, each requiring tailored management strategies.[7] While small avulsion fractures may be managed conservatively, most fractures—especially oblique, vertical, or comminuted—require internal fixation. Surgical fixation techniques depend on fracture morphology and bone quality, with lag screw fixation being one of the most commonly employed methods. The choice between partially threaded and fully threaded lag screws, as well as between unicortical and bicortical fixation, remains a topic of ongoing research and debate. The biomechanical principles of screw fixation, such as interfragmentary compression and the selection of appropriate screw type, length, and insertion angle, are critical to achieving stable fixation and promoting fracture healing.[5] The design and threading pattern of the screw significantly influence its mechanical performance. Malleolar screws, in particular, are designed to maximize purchase in dense cortical bone and are often used with washers to increase the surface area for compression. Given the importance of optimizing fixation to prevent complications like screw loosening and nonunion, this study aims to compare the clinical and radiographic outcomes of medial malleolar fracture fixation using bicortical fully threaded lag screws versus unicortical partially threaded lag screws. Aim of the Study: to compare the clinical and radiological outcomes of medial malleolar fracture fixation using bicortical fully threaded lag screws versus partially threaded malleolar lag screws.

METHOD

This prospective randomized controlled study was conducted at the Orthopedic Clinic of Al-Kadhimyiah Teaching Hospital between August 2011 and August 2013. A total of 22 patients diagnosed with medial malleolar fractures were included after meeting the inclusion criteria. Patients were admitted within 24 hours of injury and underwent surgical fixation within the same time frame. Written informed consent was obtained from all participants after a full explanation of the study's purpose and procedures. The patients were randomly allocated into two treatment groups. Group A (n=11) underwent fixation using unicortical partially threaded (PT) malleolar lag screws, while Group B (n=11) received bicortical fully threaded (FT) cortical lag screws. Both groups were followed postoperatively for up to 24 weeks. Inclusion criteria included patients aged 18–50 years with displaced medial malleolar fractures. Exclusion criteria included open fractures, fractures with open epiphysis, and previous medial malleolar fractures. Preoperative evaluation included clinical assessment of the mechanism of injury, physical examination for deformity, neurovascular status, and skin condition. Standard blood tests, ECG, and chest radiographs were obtained for all patients. Surgical procedures were performed under general anesthesia with tourniquet control. A Broomhead medial approach was utilized in most cases, exposing the medial malleolus while preserving the deltoid ligament. Fractures were reduced and fixed using the appropriate screw technique based on group allocation. Screw length was determined intraoperatively, and proper compression was ensured. Postoperatively, all patients received standard care including immobilization, non-weight bearing, and progressive rehabilitation. Follow-up included clinical and radiographic assessments at 2, 5, and 6 weeks, with further evaluation up to 24 weeks. Radiographs were taken using anteroposterior, lateral, and mortise views to monitor fracture union and detect complications.

FIG. 1: Holding reduction.

FIG. 2: Drilling for screw.

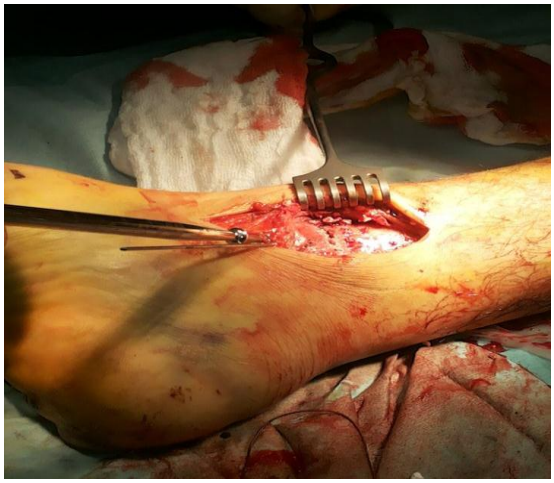

FIG. 3: Screw Incretion.

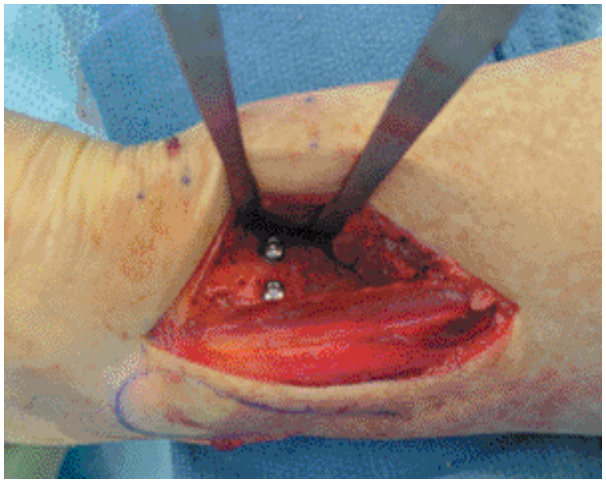

FIG. 4: Screws After Fixation.

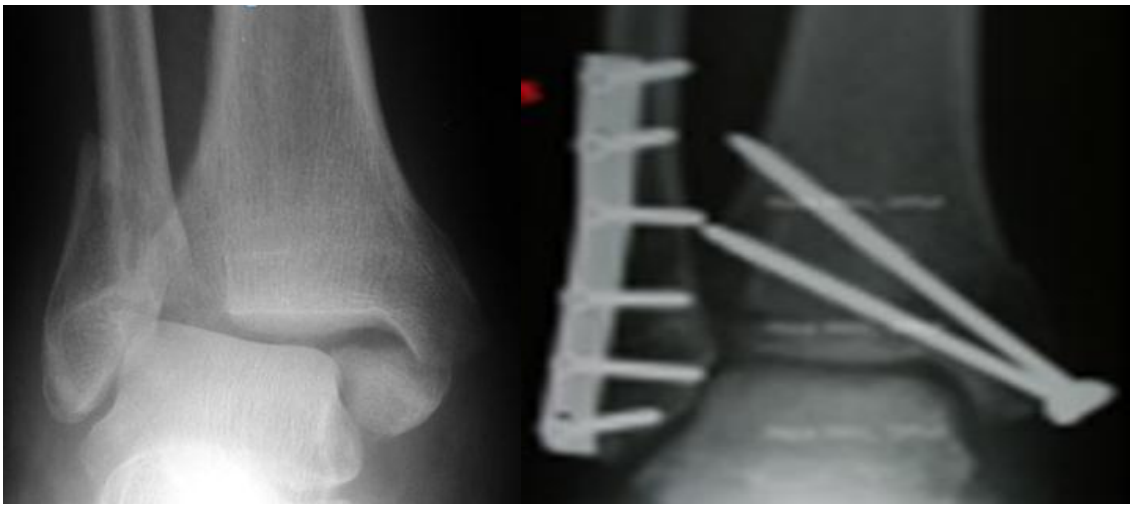

FIG. 5: Ft Screws.

RESULTS

Fixation of medial malleolar fractures is frequently carried out using unicortical partially threaded (PT) cancellous lag screws. However, the optimal length of these screws remains uncertain. The demographic characteristics of the patients—including age, gender, and the fracture patterns—are summarized in the following table.

Table 1: Patient Demographics and Fracture Patterns.

Parameter	Group A (PT Screw - Unicortical)	Group B (FT Screw - Bicortical)
Number of Patients	11	11
Age Range (years)	18–48	18–50
Male	4	3
Female	7	8
Fracture Pattern: Oblique	8	0
Fracture Pattern: Transverse	3	0
Fracture Pattern: Long Oblique	0	9
Fracture Pattern: Vertical	0	2

Loosening occurred in 3 out of 11 patients (27.2%) in Group A (PT unicortical screws). Two of these patients required reoperation due to symptomatic hardware-related pain. In contrast, no cases of loosening or hardware removal were reported in Group B (FT bicortical screws). As in fig 1.

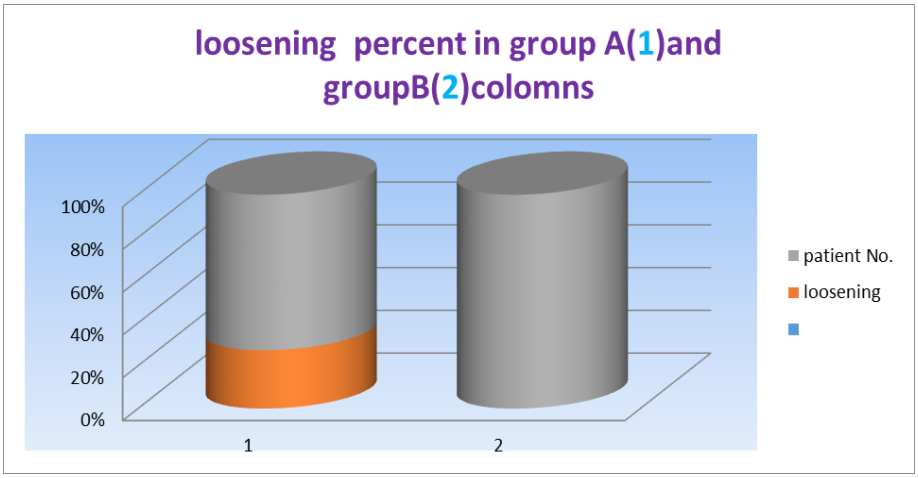

Fig. 1: loosening percent in group A and group B.

Nonunion was observed in 2 out of 11 patients (18.2%) in Group A (PT unicortical screws). Both patients experienced mild to moderate pain at the fracture site and subsequently required further surgical intervention. No cases of nonunion were reported in Group B (FT bicortical screws). As in fig 2.

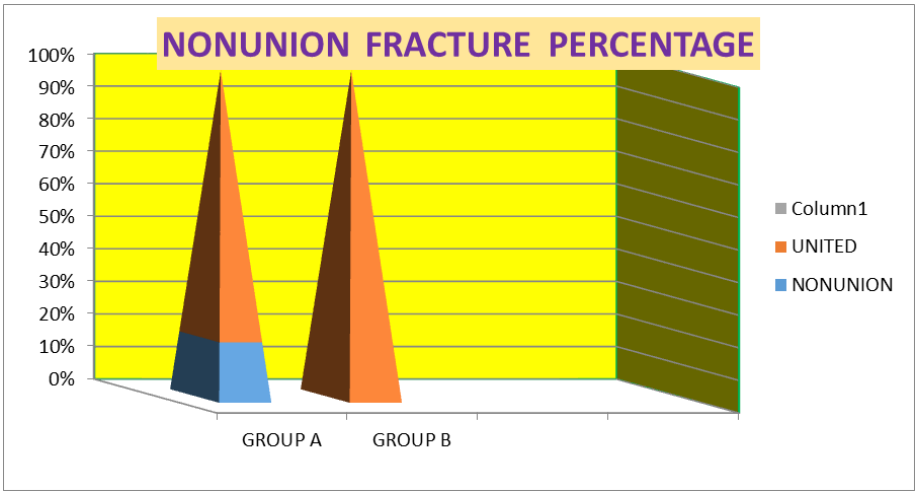

Fig. 2: Nonunion fracture.

Superficial infections occurred in one patient from each group—Group A (PT unicortical screws) and Group B (FT bicortical screws)—resulting in an infection rate of 9.09% per group. Both infections were managed without major complications. As in fig 3.

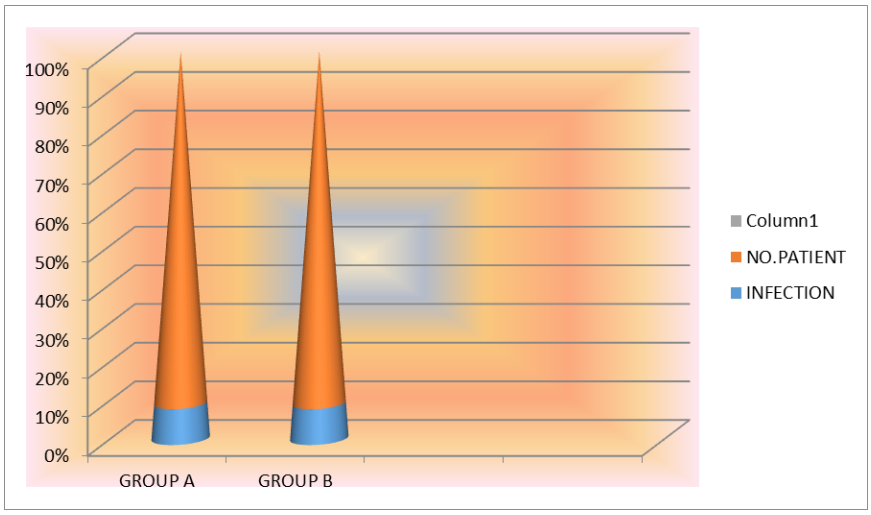

Fig. 3: infection.

This study demonstrated that bicortical fully threaded (FT) lag screws provide superior biomechanical stability compared to unicortical partially threaded (PT) screws, offering greater torque, compression, and resistance to loosening. FT screws showed stronger fixation under transverse and tension loads. Proper screw length is critical; PT screws should be 40–50 mm to ensure full thread engagement, while FT screws typically range from 60–105 mm. Lagging by "method" (FT) proved more reliable than lagging by "design" (PT). Radiographic follow-up confirmed lower rates of loosening and nonunion with FT screws. Weight-bearing was introduced progressively postoperatively. Hardware removal was considered only for symptom relief or syndesmotic screw removal.

DISCUSSION

Operative fixation of ankle fractures, including medial malleolar fractures, generally yields favorable outcomes. However, persistent postoperative symptoms related to implant irritation remain a significant clinical issue. Brown et al. reported that 31% of patients experienced implant-related ankle pain, and 23% either underwent implant removal or expressed a desire for removal due to discomfort or limitations in mobility.[8] This is particularly concerning when dealing with prominent hardware, such as screws that have loosened or backed out, which often necessitate secondary surgical intervention.[9] Partially threaded (PT) lag screws, commonly used for medial malleolar fractures, function via a "lag by design" technique. Rüedi and colleagues have long endorsed this method due to its simplicity and familiarity in orthopedic practice.[7] However, the effectiveness of these screws is highly dependent on proper length selection. PT screws must be long enough to ensure all threads extend beyond the fracture site to achieve sufficient interfragmentary compression.[10] If excessively long, these screws risk engaging areas of metaphyseal bone with lower density, increasing the likelihood of poor fixation, screw stripping, and subsequent mechanical failure.[7,11] Perren highlighted that the 4.0 mm partially threaded screw, particularly in a cannulated system, remains a preferred choice for medial malleolar fixation. Given the spongy nature of the distal tibia, cancellous pitch screws are generally recommended, with optimal PT screw lengths ranging from 40 to 50 mm.[12] Alternatively, fully threaded (FT) cortical screws using a "lag by method" technique have shown biomechanical superiority. This approach involves overdrilling the near cortex and achieving compression by engaging the far cortex with screw threads. FT screws, typically measuring 60–105 mm, provide deeper cortical engagement and higher resistance to loosening and backing out.[13] Biomechanically, FT screws exhibit over three times the maximum torque compared to PT screws, translating to increased compression at the fracture site and enhanced stability.[14] Our study supports these findings. Patients treated with FT screws (Group B) had better radiographic and clinical outcomes, with no cases of loosening or nonunion observed. In contrast, Group A (PT screws) reported three cases of screw loosening, two requiring hardware removal due to pain, and two cases of nonunion. These results align with existing biomechanical data that show bicortical lag screws provide stronger fixation under transverse and tensile loads than unicortical screws.[13,14] Thus, FT cortical screw fixation represents a more reliable method for treating medial malleolar fractures.

CONCLUSION

Lag screws placed by the "method" technique with distal cortical engagement show superior radiographic and clinical outcomes in medial malleolar fracture fixation. In contrast, partially threaded screws (lag by design) often result in poorer outcomes due to limited metaphyseal purchase. Optimal screw length is essential to achieve compression without compromising fixation. Excessive screw length risks weak hold, especially in osteoporotic bone.

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