Case Report

Intramedullary Nail Fixation for the Treatment of Symptomatic Fibular Nonunion

A Case Series

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Abstract: *Ankle fractures are a relatively common injury in the lower extremity. They can be treated with conservative management if they are nondisplaced and only involve the fibula. Nonunions at the fracture site, however, are a potential complicating factor during treatment. There is growing literature supporting the use of intramedullary fixation for fracture care. Not only does it have the advantages of using smaller incisions to preserve periosteum while providing improved biomechanical outcomes, but intramedullary reaming can help stimulate cells to promote bone healing. Few articles discuss the use and success of intramedullary reaming in revision surgery of the distal fibula. We present 3 cases of computed tomography–confirmed fibular nonunion following conservative fracture care, which underwent revision surgery with fibular nail fixation technique. These cases illustrate clinical and image findings as well as highlight the surgical technique used for each patient. At follow-up, all patients were asymptomatic and radiographs confirmed healing of the previous nonunion site. These cases are examples of successful revision for fibular fracture nonunion using intramedullary nail fixation.*

Level of Evidence: *Level IV: Case series*

Keywords: fibular fracture; Weber B fracture; nonunion; delayed union; fibular nail; intramedullary reaming; intramedullary fixation

Introduction

Ankle fractures are common injuries that make up approximately 10% of all fractures in the body.[1] It has been documented that the incidence of these fractures is 4.22 per every 10 000 persons each year.[2] Nonunion is a complication in the treatment of ankle fractures, with a rate of anywhere between 4.3% and 30%.[3,4] Usually, isolated lateral malleolar fractures that are nondisplaced or minimally displaced go on to bony union without the need for operative intervention. There are instances, however, where conservative treatment of these minimally displaced fractures has been shown to be unsuccessful.[5] Nonunion following ankle fractures can affect patient outcomes leading to continued pain, instability, and posttraumatic ankle arthritis.

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There is a lack of a standardized definition for fracture nonunion in the literature. Recent studies have defined it as “a fracture that will not heal without

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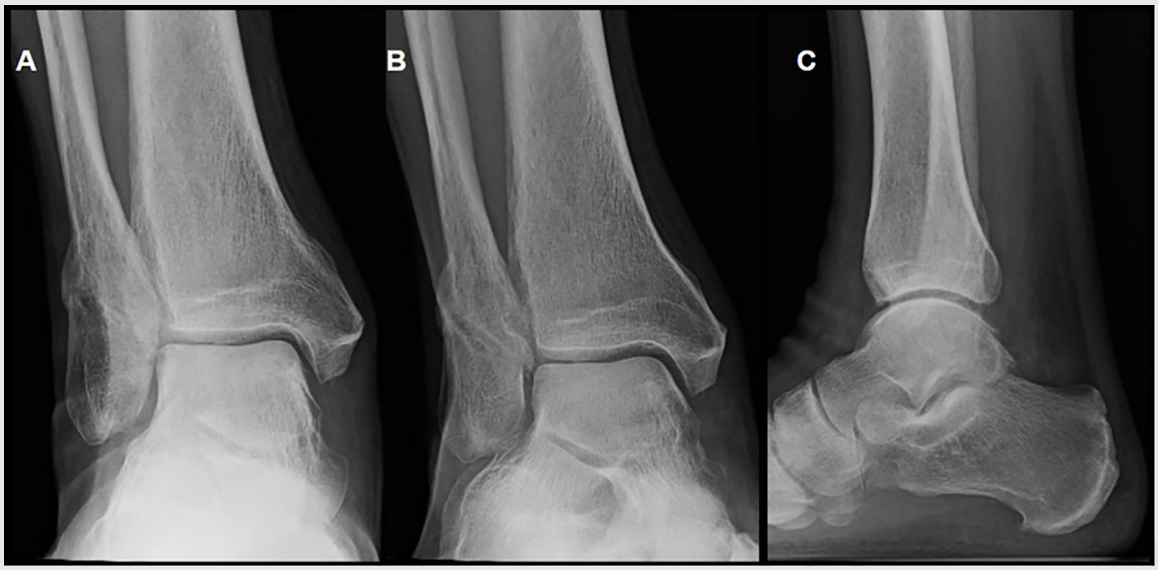
Figure 1.

Plain film radiograph: (A) Anteroposterior, (B) mortise, and (C) lateral views showing distal fibular fracture nonunion.



further intervention." It can also be based on radiographic, clinical, or time-related criteria.[6,7] In any case, nonunion should be considered when a patient has persistent pain to the area of injury with no signs of osseous healing on serial radiographs. Typically, advanced imaging in the form of a computed tomography (CT) scan is performed to better evaluate the nonunion site. When conservative treatment fails, surgical intervention is considered. The traditional method for treating these fibular nonunions involves a large open incision, mobilization of the fracture with removal of fibrous debris, reduction of fracture fragments, followed by overlying plate fixation.[4,8] Drilling of atrophic fracture ends to promote bleeding can help stimulate bony healing and subsequent grafting has also been found to increase union rates.[9] If the fracture has failed revisional surgery, another option is partial fibulectomy with resection of the nonunion site. This is only a viable choice if the nonunion is proximal to the syndesmosis or if it is a small distal avulsion of the fibula.[10]

There is a substantial amount of evidence in the literature that intramedullary reaming and fixation placement in the canal can increase rates of bony healing when treating nonunions. This has been demonstrated in several anatomic locations.[11-13] The theory behind this is that the act of reaming the intramedullary canal locally deposits internal bone grafting material consisting of mesenchymal cells, which stimulate osteogenesis at the site of nonunion. This method also reduces the risk of periosteal violation, which alters blood supply and hinders bone healing.[12]

There is growing literature supporting the use of intramedullary fixation for fracture care as it has the advantages of using smaller incisions while providing improved biomechanical outcomes. There remains little to no research discussing its use and success as a revisional surgery for distal fibular fracture nonunion or delayed union. We present 3 cases of fibular nonunion first treated with conservative management, which underwent revision surgery with fibular nail fixation technique. At final follow-up, all patients were asymptomatic and radiographs confirmed healing of the previous nonunion site.

Case Series

We present 3 consecutive patients with distal fibular nonunion who were treated with intramedullary fibular nail fixation from January 2018 to December 2022 by the senior author (B.J.B.). These patients were retrospectively reviewed. All of the patients had failed conservative treatment for their fibula fracture by an outside provider and had continued pain to the area with confirmation of nonunion on CT scan. The average length of follow-up was 147 weeks.

Case 1

A 65-year-old man who was a former smoker presented for continued right ankle pain. He had sustained a right distal fibular fracture 4 months prior to examination, for which his primary care physician had recommended nonoperative treatment. On presentation, there was moderate edema to the right ankle with tenderness to palpation of the right distal fibula. Radiographs were obtained in the office that suggested a nonunion of the fibula fracture (Figure 1). A CT scan was ordered and confirmed a subacute nonunited fracture of the lateral malleolus with minimal callus formation and intramedullary sclerosis around the fracture site (Figure 2).

The patient elected to proceed with surgical intervention for fracture fixation. He was taken to the operating room and intramedullary nail fixation across the distal fibula fracture was performed. Percutaneous reduction and intramedullary fibular reaming were done to prepare the nonunited fracture site. The fibular nail (FibuLock Fibular Nail; Arthrex, Naples, Florida) was then inserted into the distal fibula and secured with locking screws distally. He was allowed to bear weight in a tall controlled ankle motion (CAM) boot immediately following surgery. He was kept in the boot for 2 months postoperatively. Radiographs performed at 6.5 months after surgery revealed complete bony union across the fracture site (Figure 3). Final follow-up at 222 weeks demonstrated no remaining pain to the fracture site.

Figure 2.

Computed tomography scan: (A) Sagittal and (B) coronal views confirming distal fibular fracture nonunion.

Case 2

A 61-year-old man who was a former smoker had sustained a left distal fibular fracture 2 months prior to initial examination. He was treated conservatively by another physician by casting for 6 weeks followed by ambulation as tolerated in a CAM boot. On clinical examination, there was mild edema to the left ankle and tenderness to palpation isolated to the distal fibula.

Figure 3.

Plain film radiograph: (A) Anteroposterior, (B) mortise, and (C) lateral views demonstrating full bony union of the distal fibula fracture at 6.5 months postoperatively.

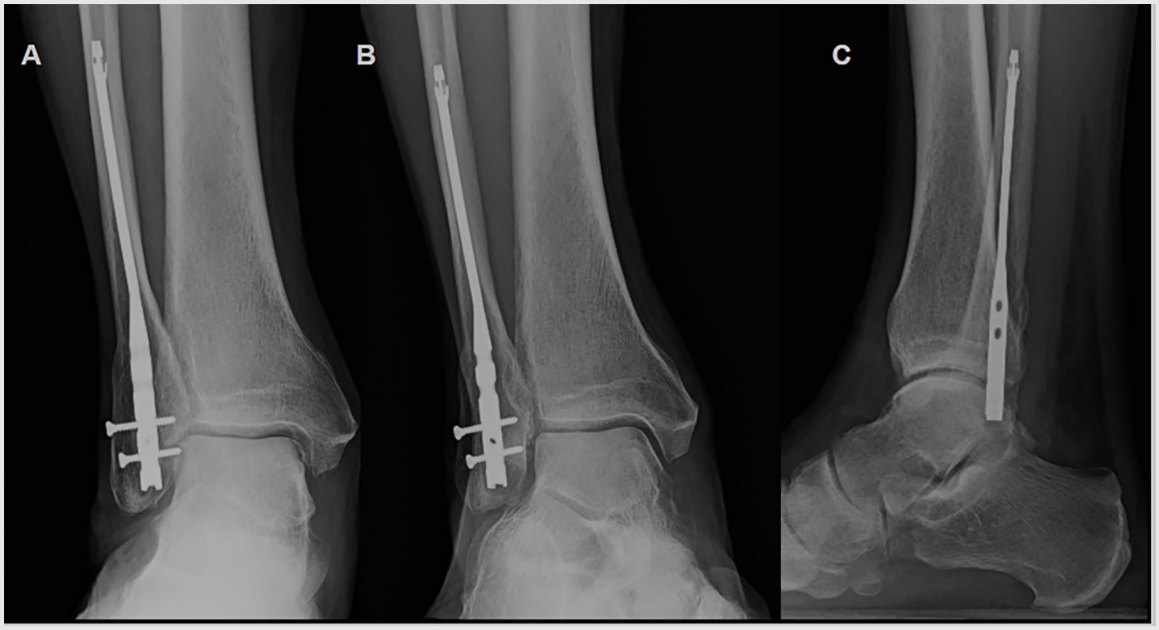


Figure 4.

Plain film radiograph: (A) Anteroposterior, (B) mortise, and (C) lateral views showing distal fibular fracture nonunion.

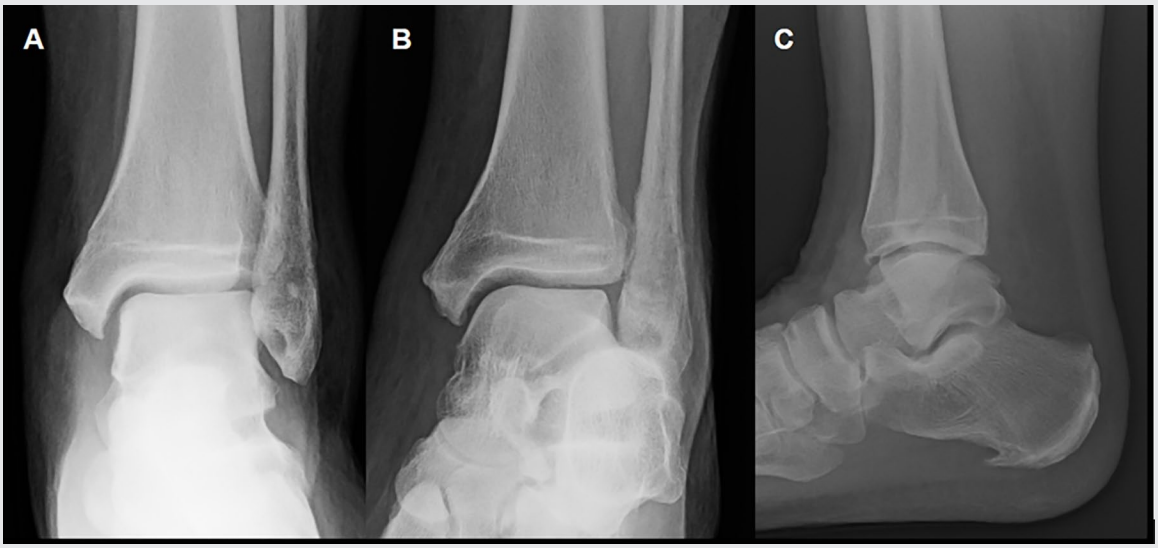


Figure 5.

Computed tomography scan: (A) Sagittal and (B) coronal views confirming distal fibular fracture nonunion.

Radiographs revealed minimal bridging across the fracture site suggestive of delayed healing (Figure 4). He was treated conservatively for another month after which time his symptoms had not improved. A CT scan was subsequently ordered that showed minimal osseous union across the fracture with sclerotic fracture margins (Figure 5).

After discussion of treatment options, the patient elected to proceed with surgical intervention. He was taken to the operating room and intramedullary nail fixation across the distal fibula fracture was performed. Intramedullary reaming was first completed to prepare the fracture site and the fibular nail (FibuLock Fibular Nail; Arthrex) was inserted into the distal fibula and secured distally with locking screws. The syndesmosis was stressed under fluoroscopy and fixated with a tricortical screw. The patient was also allowed to bear weight in a tall CAM boot postoperatively. He had no complications and went on to complete resolution of pain. Radiographs taken 5 months postoperatively demonstrated complete osseous consolidation across the fibula fracture site (Figure 6). Final follow-up at 164 weeks postoperatively revealed no issues at the surgical site.

Case 3

An 18-year-old man with no relevant past medical history sustained a left ankle distal fibula fracture after a fall off a step 5 months prior to evaluation. He had failed conservative treatment that included immobilization in a CAM boot. He complained of continued pain to the left lateral ankle. On clinical examination, there was mild edema and notable tenderness to palpation of the left distal fibula. Patient had a CT scan performed that revealed a nondisplaced fracture of the left distal fibula with sclerotic margins on either side of the fracture and no significant evidence of bony bridging (Figure 7).

Conservative versus surgical treatment options were offered and the patient

Figure 6.

Plain film radiograph: (A) Anteroposterior, (B) mortise, and (C) lateral views demonstrating full bony union of distal fibula fracture at 5 months postoperatively.

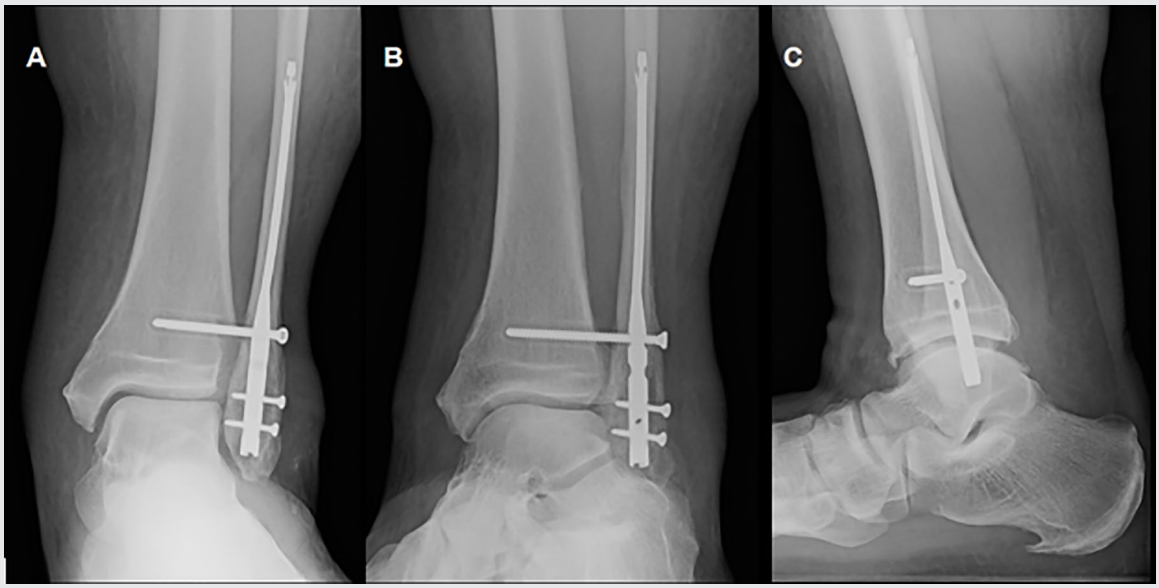
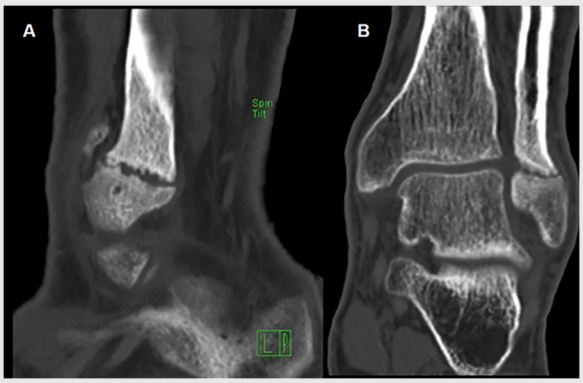


Figure 7.

Computed tomography scan: (A) Sagittal and (B) coronal views confirming distal fibular fracture nonunion.



elected to proceed with surgical intervention. He was brought to the operating room and intramedullary nail fixation across the distal fibula fracture was performed. Intramedullary reaming was used to prepare the fracture site and a fibular nail (Flex-Thread Fibular Nail; Flower Orthopedics, Horsham, Pennsylvania) was inserted into the distal fibula and secured with locking screws. The patient was kept non-weight bearing for 2 weeks following surgery and was transitioned into a tall CAM boot to begin weight bearing at his first postoperative visit. The radiographs taken at 6 months postoperatively demonstrated complete bony consolidation across the fibula fracture site (Figure 8). At final follow-up at 55 weeks, his pain had completely resolved and he was back to normal activity.

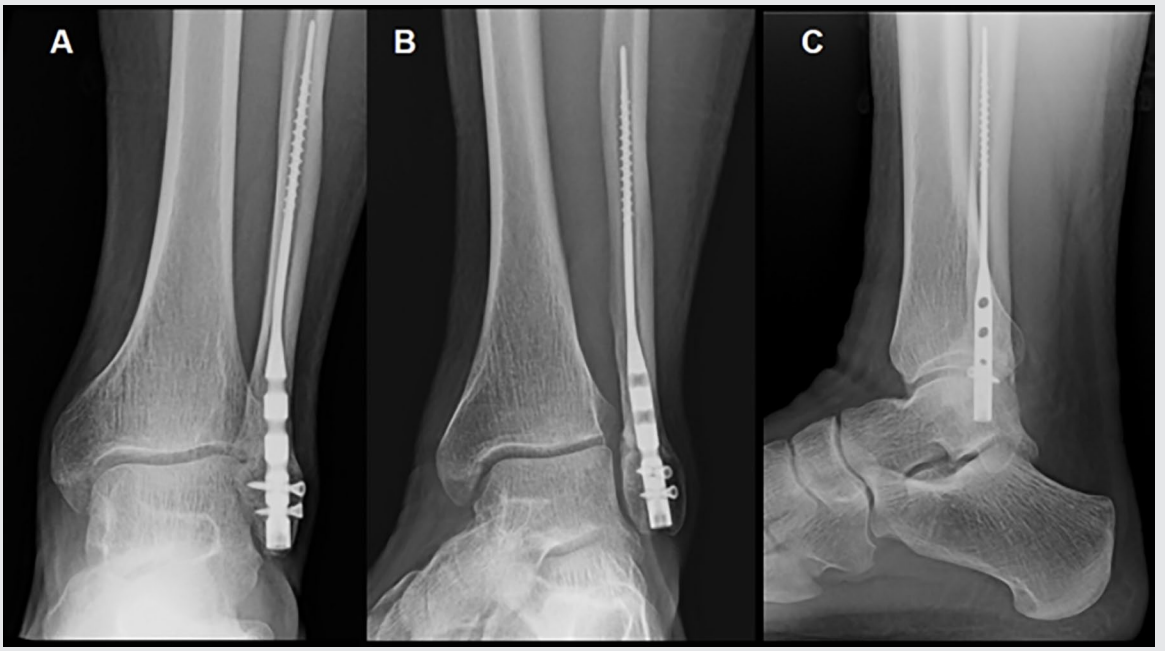
Discussion

All 3 of the cases that were presented demonstrate nonunion of a distal fibular fracture after several months of failed conservative management. All of the patients went on to full bony union at an average of 5.8 months, which was confirmed on plain film radiographs. They remained pain free at final follow-up and had no associated complications from the procedure. There is little information in the literature about performing fibular nailing for the treatment of distal fibular nonunion. Success with this method has been demonstrated for distal tibia nonunions.[11,14] There is one study by Abhaykumar that highlighted the treatment of a midshaft fibula nonunion using a closed interlocking nail.[15]

These cases are examples of distal fibular fractures that failed conservative treatment. Isolated lateral malleolar fractures that are nondisplaced or minimally displaced usually go on to

Figure 8.

Plain film radiograph: (A) Anteroposterior, (B) mortise, and (C) lateral views demonstrating full bony union of distal fibula fracture at 6 months postoperatively.



bony union without the need for operative intervention. A study by Donken et al looked into reasons why these Weber B fractures may fail. Besides preoperative risk factors such as diabetes, poor vascular supply, and poor bone density, the expression of joint instability on the initial radiographs was the most common risk factor for nonunion. Examples of these radiographic findings included medial clear space widening, fibular shortening, lateral dislocation of the distal fibular fragment of more than 2 mm, and talar tilt.[16] Therefore, stress radiographs are important in patients who present with isolated distal fibula fracture to better evaluate for this instability. The senior author was not the original treating physician in all 3 cases, so there was no access to the original plain film radiographs to see whether this was apparent at initial presentation.

The treatment of distal fibula fractures with intramedullary nailing is increasing in popularity. This fixation method was initially used in patients with poor soft tissue envelope, vascular compromise, or other comorbidities making them at high risk of wound complications.[17] As the technique has been further adopted, it has also shown to be successful in younger patients, with similar outcomes compared with traditional open reduction and internal fixation.[18,19] A study by Smith et al demonstrated that the fibular nail showed to be superior to lag screw and neutralization plate in torque to failure testing.[20] A systematic review by Backer et al also supported the use of fibular nail in the primary treatment of ankle fractures, having found an average bony union rate of 99.1% with fewer overall complications when compared with plate fixation.[21] A meta-analysis by Attia et al compared the fibular nail with traditional plating and found nailing to have higher functional outcomes scores, lower complications, and lower infection rates. Patients were more successful in performing a number of activities of daily living postoperatively.[22]

The goal for the treatment of a fibular nonunion is to achieve bony union in addition to restoring normal length and alignment at the level of the ankle joint.[11] It may not always be necessary to perform an open dissection and reduction of the fracture. Closed treatment with intramedullary nailing has shown to be successful in the management of long bone nonunions for a variety of reasons. First, its minimally invasive technique supports biological osteosynthesis via preservation of the surrounding soft tissue envelope. This reduces the risk of periosteal stripping, devascularization, secondary intraoperative infection, and bacterial contamination at the fracture site.[12] Next, the act of reaming the intramedullary canal provides biological augmentation directly to the nonunion site.[11,12] Finally, using the nail as a fixation construct increases both rotational and axial stability at the nonunion site.[14] A study by Smith et al found that fibular intramedullary nailing was superior to plating with greater torque to failure and

better maintenance of the fibular construct.[20] These key factors create an optimal biological and mechanical environment for bone healing.[12]

We recognize shortcomings of the present study. This is a small case series and therefore it is difficult to make definite conclusions about the use of fibular nailing in the treatment of nonunions. There was also a lack of a comparative group to test the use of the fibular nail technique against. It would be beneficial to see the results of this technique on a larger sample size as well as to evaluate operative time and outcomes as compared with traditional open management and plating of fibular nonunions. Finally, all patients were treated nonoperatively first and it is possible that simply lack of mechanical stability was the reason for nonunion. Fixation leads to increased stability, which has been found alone to improve healing rates by limiting motion at the fracture site.[23] While fixation may have been the missing piece in the treatment of these nonunions, the fibula nail still showed to be a successful fixation construct while keeping incisions smaller as compared with traditional open debridement of the nonunion site.

Conclusion

There is a lack of literature evaluating clinical and radiographic outcomes of an intramedullary nail fixation system for surgical treatment of distal fibula fractures with confirmed nonunion. The early results observed in this study demonstrate that utilization of this intramedullary device is both safe and effective for management of these fractures. In conclusion, we found that intramedullary nailing of fibula fracture nonunions was effective in promoting union.

Author Contributions

All authors provided substantial contributions to conception and design, acquisition of data, drafting the article, revising it critically for important intellectual content, and approved the final version for publication.

Declaration of Conflicting Interests

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Ethical Approval

Not applicable, because this article does not contain any studies with human or animal subjects.

Informed Consent

Informed consent was obtained from each patient for the publication of this study and accompanying images.

Trial Registration

Not applicable, because this article does not contain any clinical trials.

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