Original Article

The Clinical Outcome of Combined Distal Third Tibial and Fibular Fracture Treatment with or without Fibular Fixation: A Retrospective Study

Mohsen Khorrami, Payam Mohammadhoseini, Milad Vakilian, Amir Khorrami, Yasaman Khorrami

Department of Orthopedics, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran

ORCID:

Mohsen Khorrami: https://orcid.org/0000-0001-6365-2952
Payam Mohammadhoseini: https://orcid.org/0000-0002-3135-3285
Milad Vakilian: https://orcid.org/0000-0002-2872-8760
Amir Khorrami: https//orcid/0000-0002-9181-758x
Yasaman Khorrami: https//orcid/0000-0003-0798-8851

Abstract

Background and Objectives: Distal tibial and concomitant fibular fracture is a common fracture. Fibular fixation in conjugation with tibial fixation with a locking plate is controversial. This study aimed to determine the effect of fibular fixation in distal tibial fracture fixed with a distal medial locking plate. **Methods:** This retrospective study was conducted on 33 patients with mixed distal tibial and fibular fractures referred to the trauma centers of Golestan and Aria hospitals in Ahvaz, Iran, and underwent surgery between September 2018 and January 2019. The patients were categorized into Group I with fibular fixation ($n = 17$) and Group II without fibular fixation ($n = 16$). Then, they were divided into two subgroups according to the level of fibular fracture. For the subgroup (a), fracture was at 7.5 cm distal fibular ($n = 11$) and for the subgroup (b), proximal to group "a" at distal third ($n = 6$). Data were collected by asking patients about their function and pain in daily activities and performing examination and radiographs 6 months postoperatively. The assessment of the ankle was performed using the AOFAS. Data were analyzed using Chi-square and *t*-test by the SPSS version 26. **Results:** Six months post operation, there were no cases of malunion or wound complication in both groups. There was an osteomyelitis case in Group II, but none in Group I. There were six nonunions in total: two in Group I and four in Group II ($P = 0.325$). Furthermore, AOFAS was significantly greater in Group I compared to Group II (76.18 ± 17.45 vs. 50.62 ± 18.88, $P < 0.001$). **Conclusions:** According to the findings of the present study, there is a positive and crucial relationship between fibular fixation and AOFAS in ankles with the combined distal third tibial and fibular fracture. There are no crucial differences in nonunion of tibia, malunion, wound complication, deep infection, and osteomyelitis between nonfixation and fibular fixation.

Keywords: Clinical consequence, combined fibular tibial fracture, distal tibial fracture, fibular fixation

Introduction

Tibial fracture caused by trauma was reported as the most common fracture in the United States in 2012.[1] In 80% of tibial fractures, there is a concomitant lower fibular fracture.[2] The fixation of distal tibial fracture is demanding because of restricted soft tissue, superficial site of the bone, low vascularity, and restricted surgical incisions in this area.[3] Nonoperative remedy can be used for minimally displaced fractures or inoperable patients. Surgical treatment includes external fixation or open reduction with internal fixation with locking plates. Recently, there have been generated some optional fixation strategies, including intramedullary nail and minimally invasive percutaneous plate osteosynthesis to

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Address for correspondence: Dr. Milad Vakilian, Department of Orthopedics, Ahvaz Jundishapur University of Medical Sciences , Golestan Hospital, Ahvaz, Khuzestan, Iran.
E-mail: vakilianmilad@gmail.com

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confine the surgery-related complications. The most common complications are infection, malunion, delayed or nonunion, and posttraumatic arthritis for intra-articular injuries.[4] Distal tibial fracture prognosis depends on comminution, soft-tissue injury, and fracture displacement.

Fibular stability is crucial in ankles with syndesmotic injury or pilon fractures. However, fibular fixation in nonarticular distal tibial fractures is controversial.[5-7] Anatomically, the fibula can tolerate between 3% and 16% of the axial loads of the leg.[8]

Fibular fixation results in more control of the longitude and rotation of the fixation construct and results in a more effective anatomical alignment.[9] Conversely, fibular fixation may lead to the nonunion or delayed union since it hinders the cyclic loading on the tibial fracture site.[10]

According to one study, concomitant fibular plate fixation in tibial nailing raised the rotational stability of the construct in comparison with intramedullary nailing of tibia alone.[11] Morin showed significant differences in axial rotational stability when the fibula was fixed. However, this discrepancy may not be clinically significant for patients.[6] Teitz followed ankles with distal tibial fractures and intact fibula postoperatively. There were 61% complication rates, including 22% delayed union, 4% nonunion, and 26% malunion of the tibia. They concluded intact fibula results in tibiofibular length discrepancy, which were led to the development of tibiofibular strain pattern alteration. Teitz *et al*. suggested that intact fibula or anatomic fibular fixation can raise tibial malunion.[12] Bhandari *et al*. reached the same results.[13] Whorton and Henley posited that fibular fixation did not change outcomes of open tibial fractures when there are no syndesmotic and mortise-related injuries.[14]

However, Varsalona and Liu concluded that when there is no syndesmotic injury in distal tibial fracture, fibular fixation is not indicated.[15] Strauss *et al*. analogized the fixation results of the distal tibial fracture fixed with a locked plate or nailing, with and without fibular fracture. In axial compression, the plate was much more rigid than the nail (twice), indicating a more effective function in the frontal and sagittal plane. Fibular fracture at the same level reduces the mechanical stability of both devices, especially with nail fixation.[16]

According to Bonnevialle *et al*., fibular and tibial fractures should be accounted for a single biomechanical and pathological structure, and confirmed fibular fixation increases the fixation stability and results in tibial reduction. They also stated that when the tibia was fixed with a plate or external fixation, fibular fixation did not increase the fixation stability.[17] Egol *et al*. worked on 72 subjects reporting that malalignment in the fibular fixation group was lower than tibial fixation alone.[18]

Berlusconi *et al*. in one study conducted in 2012 on 55 patients showed that fibular fixing did not crucially influence union of the tibia. This study indicated a greater nonunion rate when the fractures of the tibia and fibula were at the same level. In their study, the tibia was treated with a bridging plate and the fibular fixation was not done.[19]

Rouhani *et al*. suggested no advantages in fibular fracture fixation concomitant with a distal third of the tibial fracture. Moreover, they did not report an increase in complications after fibular fixation.[20] Heshmati *et al*. showed that although fixing the fibula prolongs the surgery, patients have better clinical outcomes.[21]

It is clear that it is inconsistent with the fibular fixation in the fixation of distal tibial fractures, and data about the impact of fibular fixation in distal tibiofibular fractures are limited. The present study aimed at evaluating the effect of fibular fixation in mixed distal tibial and fibular fractures focusing on patients' clinical outcomes.

Subjects and Methods

This retrospective cross-sectional analytical study was performed, between September 2018 and January 2019, on 33 patients (25 males) of 36.06 ± 12.34 years' old (range, 16–67 years) with distal tibial and fibular fractures who underwent surgery at the Trauma Centers of Golestan and Aria hospitals in Ahvaz, Iran. The present study was approved by the Ethics Committee of Ahvaz Jundishapur University of Medical Sciences (Code of Ethics: IR.AJUMS.REC.1398.879), and all the patients were asked to sign the written informed consent. Sampling was performed nonrandomly, and all eligible patients with this fracture who had undergone surgery in the orthopedic department were included. Patients with nonarticular distal tibial metaphyseal fractures combined with a fibular fracture at or above the level of the distal tibiofibular joint (AO/OTA 43 A13) were included (77 patients). Patients with evidence of syndesmotic injury or open fractures Gustilo Type II and III were excluded (34 patients).

Patients with refractures, pathologic fractures, articular involvement, vascular and soft-tissue injuries, multiple fractures, chronic systemic or infective diseases that impaired bone healing processes such as diabetes mellitus, and smoking were excluded. Before the fixation of the tibia, we fixed the fibula by a 3.5 mm DCP (Dynamic Compression Plate) or one-third tubular plate with lateral incision.

The postoperative period in all patients was the same. Postoperatively, the leg had elevation, ice pack, and gentle foot and ankle joint movements. Absolute nonweight bearing walking for a 6–12-week postoperative period was necessary according to comminution. The weight-bearing began after the progression of the fracture healing progressed and the radiological bony union. Six months post operation, the patients were assessed. We collected the data through verbal communication, clinical examination, and radiography. Tibial malalignment was evaluated on postoperative radiographs. The tibial angulation (varus or valgus) was assessed by specifying the angle formed by the angle between the perpendicular lines of the proximal and distal articular surface of the tibia on AP radiographs. After 6 months, the ankles' range of motion was measured (dorsiflexion and plantar flexion) and clinical evaluation of the rotational alignment of the ankle was done. The ankle was functionally assessed through the AOFAS

(American Orthopaedic Foot and Ankle Society) clinical assessment criteria.

Based on fibular fracture fixation, the patients were categorized into Group I with fibular fixation ($n = 17$) and Group II without fibular fixation ($n = 16$) and then into two subgroups according to the level of the fibular fracture. Group I (a) ($n = 11$) and II (a) ($n = 8$) fractured at 7.5 cm distal fibular and Group I (b) ($n = 6$) and II (b) ($n = 8$) proximal to group "a" at distal third [Figure 1].

Data were analyzed using descriptive statistics (frequency [percentage] and mean ± standard deviation) and inferential statistics (Chi-square test and independent *t*-test) by the IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp software. $P < 0.05$ was considered statistically significant.

Results

Six months post operation, there were no malunion or skin and wound complication in either group. There was one case of osteomyelitis in the nonfibular fixation group but none in the group with fibular fixation. There were six nonunions in total: two in Group I and four in Group II, with no differences between the two groups ($P = 0.325$).

Moreover, AOFAS clinical criteria were significantly larger in Group I than in Group II (76.18 ± 17.45 vs. 50.62 ± 18.88, $P < 0.001$). In Group I (a), a significantly greater AOFAS was observed compared to Group II (a) (70.09 ± 18.59 vs. 50.75 ± 23.13; $P = 0.006$). Similarly, In Group I (b), fibular fixation resulted in a significant increase in AOFAS compared to Group II (b) (87.33 ± 7.22 vs. 50.50 ± 15.12; $P = 0.005$). In addition, there was a significant difference in AOFAS clinical criteria between Groups I (a) and I (b) (70.09 ± 18.59 vs. 87.33 ± 7.22 $P = 0.048$). However, no significant difference was found in AOFAS clinical criteria between Groups II (a) and II (b) (50.75 ± 23.13 vs. 50.50 ± 15.22 $P = 0.98$). There was one case of fibular nonunion in Group IIb who his tibia had complete union but because of pain and limping he candidate for fibular nonunion surgery [Figure 2].

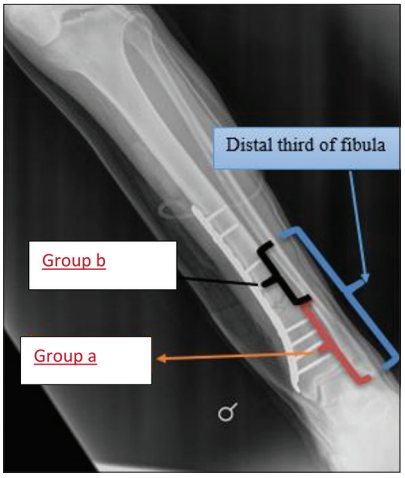

Figure 1: Classification based on fibular fracture level

Discussion

In the present study, after 6 months, there were no malunion or skin and wound complication in both groups. There was one case of osteomyelitis in Group II and none in Group I. These differences were not significant.

After 6 months postoperatively, of 33 patients, there were six (18.1%) nonunions: two in Group I and four in Group II. No crucial discrepancy was observed between the two groups. Varsalona and Liu reported that in nonarticular fractures of the tibia, fibular fixation had no effect on the fracture union, which was consistent with this survey. However, Collinge *et al*.,[22] Zelle *et al*.,[23] and Vallier *et al*.[7] reported a crucial increase in tibial nonunion with fibular fixation.

Berlusconi *et al*. showed that fibular fixation had no significant effect on tibial healing and union of the tibia. They found no correlations between open injuries, AO classification, the device used for tibial fixation, level of the fibular fracture, and the development of a tibial nonunion. However, Berlusconi *et al*. demonstrated a greater nonunion rate when the fracture of the tibia and fibula was at the same level and the tibia was treated with a bridging plate without fixing the fibula. Therefore, they recommended fibular fixation in all the distal leg fractures in which both fractures are at the same level; the tibial fracture is relatively stable.[19]

With fibular fixation at any level (Groups I[a] and I[b]), AOFAS clinical criteria were crucially greater compared to nonfixation (Groups II[a] and Group II[b]). Pogliacomi *et al*. analyzed combined fractured patients to study how the level of fibular fracture affects. They evaluated clinical outcomes using Olerud–Molander Ankle Score and the Disability Rating Index. Malrotation was also assessed as well as the incidence of nonunion and malalignment through X-rays. No differences in clinical scores were reported at follow-up between fibular fixation and nonfixation. However, there was a crucial greater incidence of external malrotation and valgus malalignment in patients without fibular fixation. They concluded that in supra-syndesmotic fractures, osteosynthesis results in a higher nonunion rate. Fibular osteosynthesis could, therefore, prevent malrotation and malalignment and is advisable in distal metaphyseal fractures (trans- or infrasyndesmotic lesion) with syndesmotic injury.[24]

Conclusions

According to the findings of the present study, there is a positive and crucial relationship between fibular fixation and AOFAS clinical criteria score in people with the combined distal third tibial and fibular fracture, even fibular fixation in group Ib increases the AOFAS clinical criteria score more than Group Ia; this means that patients with fibular fracture in zone "b" benefit more from fibular fixation than patients with fibular fracture in zone "a." There was no association between fibular fixation and the rate of complications, such as

Figure 2: (a and b) Postoperative lateral view radiography of a 19-year-old patient with distal third tibial and fibular fracture without fibular fixation. (c and d) After 6 months, the tibial union is complete, but fibular nonunion is obvious (because the patient was painful he candidate for surgery for fibular nonunion)

nonunion, malunion, wound complication, and osteomyelitis. Sample sizes in most studies on the topic are limited, thus further robust studies in this field seem necessary.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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