Should We Pay Attention to the Fibular Segmental Fracture in the Management of Leg Fractures?

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Abstract

Background: Fibular fractures are the most common associated fractures with tibia injuries. The current study aimed at collecting data on segmental fibular fractures in the patients and investigating the prognostic and functional significance of this injury pattern in outcomes.

Methods: The charts were retrospectively reviewed from 2013 to 2016 to find patients with segmental fibular fractures. Patients' history, physical examinations, initial radiographic findings, surgical reports, and follow-up data were evaluated. The patients were also assessed for union status, infection, limb shortening, and complications. Fractures were defined as segmental when the bone was disrupted in 2 points and a segment of bone with circumferential cortices was apart from the main bone proximally and distally.

Results: During the 3-year period of the current study, out of 212 patients with leg fracture (tibiofibular fracture) treated in Imam Khomeini hospital, 17 patients (8%) had segmental fibular fractures. In the observed fibular fractures, the number of fracture fragments was between 3 and 6 segments. After 6 months, the rate of union was 70% in the tibia and 88% in the fibula. Overall, 6 patients needed re-operation, 1 of them had below knee amputation, and 5 other had surgeries because of tibial nonunion.

Conclusions: The current study results showed that presence of a segmental fibular fracture may be associated with higher rates of complications. Fixation of the fibula in this situation can lead to nonunion. However, more studies are needed to approve or reject this conclusion.

Keywords: Segmental Fracture, Fibula Fracture, Outcomes

1. Background

Fractures of the tibia and fibula are relatively common and recognized as serious and debilitating injuries for centuries (1). Fibular fractures are the most common associated fractures with tibia injuries. Despite the high prevalence of fibular fractures, it receives less attention by orthopedic surgeons. About 7% to 15% of body weight is tolerated by fibula and it plays an important role in knee and ankle stability (2). Although isolated fibular fractures occur in only 0.6% of leg fractures (1), tibia injuries are frequently accompanied by fibular fractures, especially in the context of high-energy trauma. In a literature review, most of the articles found about the fibular fractures are the ones associated with ankle injuries and in the zone of the lateral malleolus. It seems that except lateral malleolus fractures, most other fibular injuries do not alter the therapeutic approach, although it might have some prognostic values. According to the current study findings, some tibiofibular fractures had a segmental fragment. According to the data presented by Ramasamy, about 16% of fibular fractures are segmental (3). There is a paucity of the literature in the field of fibular fractures. Paying attention to these frac-

tures in addition to tibia fractures, and reporting the data can fill this defect. The current study aimed at collecting data on fibular segmental fractures in the patients and investigating the prognostic and functional significance of this injury pattern in outcomes.

2. Methods

The current study retrospectively reviewed the charts of all tibia and/or fibula fractures admitted to Imam Khomeini hospital, Tehran, Iran, from 2013 to 2016, to find patients with segmental fibular fractures. All tibiofibular fractures were include and all leg X-rays reviewed; after selecting the patients with segmental fibular fractures, patients' history, physical examinations, initial radiographic findings, surgical reports, and follow-up data were assessed. The patients were also assessed for union status, infection, limb shortening, and complications. During the follow-up, anteroposterior and lateral full-length radiographs of the injured legs at the last visit were obtained. Fractures were defined as segmental when the bone was disrupted in 2 points and a segment of bone with circum-

ferential cortices was apart from the main bone proximally and distally (4).

3. Results

During the 3-year period of the study, out of 212 patients with leg fracture (tibiofibular fracture) that were treated in Imam Khomeini Hospital, 17 (8%) cases had segmental fibular fractures. Fourteen patients were male. Mean age was 35.6 ± 3.9 years, ranging from 23 to 61. The mechanism of injury for all the patients was road accidents (11 motor vehicle accidents, 6 pedestrians hit by a motor vehicle). Eleven patients had open tibia fractures; none had open fibular fractures. Two patients needed a skin graft and no patient needed vascular surgery. Mean follow-up was 22 ± 7.58 , ranged 12 to 36 months. Six patients had injuries associated with other limbs or organs including intracranial hemorrhage needing neurosurgical intervention ($n = 1$), contralateral proximal humerus fracture ($n = 1$), ipsilateral olecranon fracture ($n = 1$), ipsilateral femoral fracture ($n = 1$), and ipsilateral metatarsal fractures ($n = 2$).

Open reduction internal fixation (ORIF) was performed in 2 of the fibular fractures (only the distal fracture line of the segmental fracture), as the fracture was in the lateral malleolus zone. The other 15 fractures were not fixed.

Tibia fractures in the patients were repaired by different methods according to fracture type and soft tissue status: 7 by intramedullary nailing, 5 by plate fixation, and 5 by external fixations. In the external fixation group, 3 patients underwent secondary nailing and 2 had external fixator as definitive treatment (Figures 1 to 3). In the fibular fractures, the number of fracture fragments was between 3 and 6 segments with no correlation with the number of tibia fractures fragments (based on Pearson correlation analysis) (Table 1).

The anatomic locations of tibia fractures were in proximal third ($n = 3$), middle third ($n = 7$), and distal third ($n = 7$). One of the patients had hemophilia and compartment syndrome, and eventually underwent a below knee amputation because of severe necrosis and resistant infection. After 6 months from injury, 5 patients (29.4%) had tibia nonunion (that was infected in 4 cases) that underwent surgery/surgeries for infection treatment and nonunion repair. Of these 5 patients, 2 (11.7%) also had fibular nonunion; both had previous ORIF of fibular fracture (fibular fracture fixed only in these patients internally).

Out of the 17 patients, 7 (41%) needed another surgery: 5 due to nonunion (all with infected nonunion, except one), 1 for osteomyelitis (infected union), and another one for the unviable limb. Tibial nonunion repaired in all patients, 12 months after the injury. All the patients were ambulatory at the end of follow-up. The knee range of motion

(ROM) was normal in all patients, but ankle ROM was restricted severely in 1 patient.

4. Discussion

In the review of the literature, only 1 paper discussed segmental fibular fractures in association with a tibia fracture. The current study used PubMed database for the literature review and used “Fractures, Bone” and “Fibula” and segmental as keywords. Ramasamy suggested that segmental fibular fractures are associated with high energy trauma, more open wounds, and more complications (nonunion, infection, and skin loss) compared with tibia fracture with a simple fibula fracture (3). There was no finding on the management and employment of approaches for such patients in the mentioned article.

In Ramasamy's article, open fracture in the group with non-segmental fibula fractures was 53%. In the current study, the prevalence of open fracture was 64.7% in 17 patients with a fibular segmental fracture. It was comparable to the results reported by Ramasamy. The current study, the rate of open injuries in fibular fractures was significantly higher than that of tibia fractures with no segmental fracture (P -value = 0.031). It may implicate that these fractures are a sign of high-energy trauma.

The incidence of infection in the current study patients was also similar to that of Ramasamy (35% vs. 34%, respectively). After 6 months, the rate of union was 70% in the repaired tibia and 88% in the repaired fibula. In the previous literature, the rate of tibial union in surgical treatment and the closed fracture was 92% to 99% (5-7). The rate of union in open fractures was 76% to 94.7% (5, 8, 9). In comparison, in the current study nonunion rate was higher than the ones with closed fracture (P -value = 0.039), but not significantly superior to open fracture (P -value = 0.320).

There is no evidence based on the proper treatment of fibular fractures (including simple or segmental) in patients with tibiofibular fractures. In 1982, Bostman suggested a displacement more than one-third of diaphyseal diameter as an indication for fibula fixation (10).

Some authors concluded that fibular fixation, out of the range of syndesmosis and lateral malleolus, has no clinical and simulation value and there is no need for fibula osteosynthesis (11-13).

In 1998, Williams et al. did not recommend fibula fixation in patients with tibia plateau fractures as they did not find a clinical significance and it was also associated with more complications (14). Whorton et al. said that fixation of the fibula in patients with tibia-fibula open fracture had no effect on union and alignment, but fibula fracture in the zone of syndesmosis and lateral malleolus were not included in this study (15). Barei et al., reported that

Figure 1. Leg Radiography: A) Preoperation, B) Postoperation, C) Two Months, and D) Six Months After Surgery

Figure 2. Leg Radiography: A) Preoperation, B) One Month, C) Six Months, and D) Nine Months After Surgery

Figure 3. A) Preoperation, B) Primary Temporary Fixation, C) Permanent Fixation, D) After 6 Months, E) Ilizarov Fixation

from 72 patients who underwent IM nailing for tibia fracture, 25 had concurrent fibular fixation by the plate, and

the others had no fixation. They concluded that after 12 weeks, the group with internal fixation of fibula had bet-

Table 1. Demographic Data and Medical History of the Study Cases

number	Age, years	Gender	Fx Type	Tibia Fixation	Tibia Fragment	Fibula Fragment
1	37.00	Male	Open fx	External fixation	2.00	3.00
2	38.00	Female	Close fx	Intramedullary fixation	2.00	3.00
3	24.00	Male	Open fx	Intramedullary fixation	2.00	3.00
4	26.00	Male	Close fx	Intramedullary fixation	4.00	3.00
5	37.00	Female	Open fx	Intramedullary fixation	2.00	3.00
6	61.00	Male	Close fx	Intramedullary fixation	2.00	3.00
7	52.00	Male	Close fx	Plate	2.00	3.00
8	39.00	Male	Open fx	Intramedullary fixation	2.00	3.00
9	54.00	Male	Open fx	Plate	2.00	5.00
10	31.00	Male	Close fx	Intramedullary fixation	2.00	3.00
11	36.00	Male	Open fx	Plate	3.00	3.00
12	24.00	Male	Open fx	External fixation	3.00	3.00
13	56.00	Male	Open fx	External fixation	2.00	4.00
14	26.00	Male	Open fx	External fixation	2.00	3.00
15	23.00	Male	Open fx	Plate	2.00	3.00
16	32.00	Female	Close fx	Plate	2.00	3.00
17	27.00	Male	Open fx	External fixation	4.00	3.00

ter alignments, but the authors noted that the majority of fixation group had fractures in the lateral malleolus and syndesmotic regions (16).

In the current review, in 2 cases (#9 and #12) according to the above literature indications, only the fracture line in the distal part of fibula by plate were fixed. Despite the expectations, nonunion happened in fixation site and maybe if the fixation was performed by intramedullary device or bone graft was used, these nonunion results could be avoided. In these 2 patients, fibula was segmented into 3 and 5 separate parts. Both of their fractures were open and fixed by one-third tubular plates, after primary temporary external fixator. Nonunion of tibia also occurred in both patients. It is interesting that all of the fractures that happened proximal to fixation site in the fibula were united perfectly. Therefore, infection was ruled out and plate removal was done; then, illizarov fixation was performed with bone graft for both patients. After 4 months all particles united, eventually. The current study had its limitations, the number of cases was few and the type of study was designed retrospectively. More studies are required to demonstrate fixation usefulness in segmental fibular fractures.

4.1. Conclusion

The current study results showed that presence of a segmental fibular fracture may be associated with higher rates of complications. Fixation of the fibula in this situation can lead to nonunion. However, more studies are needed to approve or reject this conclusion.

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Footnotes

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