

Does the Fibula Need to be Fixed in Complex Pilon Fractures?

John C. Kurylo, MD,* Neil Datta, MD,† Kendra N. Iskander, MD, MPH,‡ and Paul Tornetta III, MD†

Objectives: To review a series of patients with complex plafond injuries with a metadiaphyseal dissociation who did not have the fibula fixed and compare with patients who had their fibula fixed using patients without a fibula fracture as a control group.

Design: Retrospective case-control study.

Setting: Level 1 Trauma center at a university hospital.

Patients/Participants: Skeletally mature patients with a complete metadiaphyseal plafond fracture, and adequate presentation, post-reduction, and healed radiographs to measure varus and valgus alignment.

Intervention: Surgical treatment [external fixator or open reduction internal fixation (ORIF)] of high energy pilon fractures.

Main Outcome Measurements: Metaphyseal alignment at the time of presentation, after fixation, and at union, surgical procedures performed, and complications.

Methods: From 364 patients with plafond fractures, 111 had high energy injuries with metadiaphyseal dissociation and form the basis of the study. Radiographs and charts were reviewed for fracture characteristics, metaphyseal alignment at the time of presentation, after fixation, and at union, surgical procedures performed, and complications.

Results: Of the 111 study patients, 93 patients were treated definitively with ORIF of the tibia and 18 patients were treated definitively in an external fixator. Within the 93 patients treated definitively with ORIF of the tibia, we identified 3 groups of patients those with a fibula fracture that was fixed (26 patients), those with a fibula fracture that was not fixed (37 patients), and those without a fibula fracture acting as the control group (30 patients). Between the 2 groups having a fibula fracture treated with ORIF of the tibia, there was no difference in fibula fracture pattern or location.

For the 26 patients who had fibular fixation, it was performed in 11 patients at an average of 17 days for inability to hold length and alignment and in 15 patients to augment fixation in poor bone stock or to aid in the reduction. Patients with initial valgus deformity were more likely to have their fibula fixed. There was no difference in the postoperative or final alignment between the patients with fibula fractures (with or without fixation) and those without fibula fractures ($P = 0.92$). When comparing the 3 groups, the only statistical finding between the 2 groups was that those with fibula fixation required plate removal ($P < 0.0001$).

Conclusions: Fibular fixation is not a necessary step in the reconstruction of pilon fractures, although it may be helpful in specific cases to aid in tibial plafond reduction or augment external fixation. We found a higher rate of plate removal if the fibula was fixed.

Key Words: pilon fracture, interarticular ankle fracture, complex plafond injury, trauma

Level of Evidence: Therapeutic Level III. See Instructions for Authors for a complete description of levels of evidence.

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INTRODUCTION

Fractures of the distal tibia are potentially devastating injuries that are fraught with complications and poor outcomes.^{1–4} The best chance of a satisfactory outcome occurs when there is restoration of metaphyseal alignment, articular congruity, and stable fixation to allow early active aggressive range of motion.^{5–8}

Historically, the first principle of management, restoration of fibula length, was identified as being vital for obtaining good results.^{1,9} Confirming the importance of attaining proper fibular length, Babis et al¹⁰ found that the effectiveness of tibial plafond management is influenced by 3 parameters: fracture type, the quality of fibular reduction at surgery, and the method of treatment used. Subsequently, Sirkin et al¹¹ and Patterson and Cole¹² expanded upon the findings of Ruedi and Allgower and proposed a staged protocol: acute fibula reduction and stabilization and application of an external fixation, followed by open reduction and internal fixation of the tibia when the soft tissue envelope is amenable to surgery. However, in 1999, Williams et al¹³ concluded that open reduction internal fixation (ORIF) of the fibula fracture in tibial plafond fractures treated with external fixation that spans the ankle is associated with a significant rate of complications, and good clinical results may

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From the *Sports Medicine North Orthopedics, Peabody, MA; †Department of Orthopaedic Surgery, Boston University Medical Center, Boston, MA; and ‡Department of Surgery, Boston University Medical Center, Boston, MA. Presented as a Podium Presentation at the Annual Meeting of the Orthopaedic Trauma Association, October 5, 2012, Minneapolis, MN.

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Reprints: John C. Kurylo, MD, Sports Medicine North Orthopedics, 1 Orthopedic Drive, Peabody, MA 01960 (e-mail: john.kurylo@gmail.com).

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TABLE 1. Fracture Pattern of Patients Treated With Definitive ORIF of the Tibia

	ORIF Tibia With Fibula Fixation (26 Patients)	ORIF Tibia Without Fibula Fixation (37 Patients)	No Fibula Fracture (Control: 30 Patients)	<i>P</i>
Open fracture	7	9	0	0.005
Fibula fracture type				
Transverse	11	13	NA	0.58
Oblique	10	14	NA	0.387
Comminuted	5	10	NA	0.143
Pattern of fibula fracture				
Weber A	0	2	NA	0.467
Weber B	9	13	NA	0.366
Weber C	17	22	NA	0.365

NA, not applicable.

be obtained without fixing the fibula. With the advent of locked and bicolumn tibial fixation combined with periods of temporary external fixation that allows partial fibular healing, fibular fixation is no longer seen as a requirement.

At our institution, our protocol is to wait for the soft tissues to be in good condition before tibial fixation. Thus, most patients are initially treated with spanning external fixation. During the definitive fixation, fibular fixation is used only if deemed necessary, but not performed routinely.

The purpose of this study is to review a series of patients with complex metadiaphyseal plafond injuries who did not have the fibula fixed and compare them with patients who had their fibula fixed and those who did not have a fibula fracture (control). We hypothesized that with stable tibial fixation, a congruent ankle joint, and restoration of tibial length, fibular fixation is not needed in nonrotational pilon fracture patterns and may possibly lead to further complications.

METHODS

We included all patients who were skeletally mature, had complete metadiaphyseal plafond fractures, and adequate presentation, postreduction, and healed radiographs to measure varus and valgus alignment. Patients were excluded from the study population if they had a rotational fracture. The rationale for exclusion of the rotational type of injury is that the fracture fixation approach to rotational pilon/distal tibia fractures with or without a fibular fracture is different from a high-energy impaction metadiaphyseal fractures as fibula fixation can play a pivotal role in maintaining the reduction against a rotational force.

The following data were gathered from each patient: age, sex, OTA/AO classification,¹⁴ presence and classification of a fibular fracture based on the Weber fracture

classification, pattern of fibula fracture (oblique, transverse, or comminuted), grade of open fracture based on the Gustilo–Anderson fracture classification,¹⁵ medical comorbidities, tobacco use, mechanism of injury, dates of the initial and all subsequent surgical procedures, type of fixation used for the tibia and/or fibula, and complications of infection, fusion, hardware removal, compartment syndrome, and nonunion (see **Table, Supplemental Digital Content 1**, <http://links.lww.com/BOT/A301>).

Varus or valgus angulation of the joint surface was measured on a full-length tibia or ankle radiograph with a line drawn down the center of the anatomic axis of the tibia and a line at the distal tibia articular surface. The best attempt was made on the presentation films to draw this line, and the talus was used to help to guide the measurement as the joint itself was not reduced. Measurements were taken on the initial injury film, after definitive surgery, and at the patient's last follow-up visit. Patients who arrived to our clinic with an external fixator already in place were not included in the initial injury radiograph measurement group. Patients who went on to fusion or revision ORIF had their angulation recorded before undergoing the revision/salvage procedure. For statistical analysis, the alignment and change in alignment was measured as an absolute value to avoid averaging of varus and valgus angulation. To test the reproducibility of the measurements, 5 random cases were selected measured by all authors. All measurements were within 2 degrees of each other, and the remainder was measured by one observer (J.C.K.).

We compared complication rates and joint alignment of patients with fibula fractures fixed to those whose fibula were not fixed and used patients without a fibula fracture as a control group to benchmark the results. The reason for fibula fixation, when chosen, was documented. Comparison

TABLE 2. Treatment of Patients Treated With Definitive ORIF of the Tibia

	ORIF Tibia With Fibula Fixation (26 Patients)	ORIF Tibia Without Fibula Fixation (37 Patients)	No Fibula Fracture (Control: 30 Patients)	<i>P</i>
Initial ex-fix	22	34	21	0.047
Locking plate	22	18	16	0.472
Average number of OR procedures	3.1	2.4	2.2	0.124
Range	1–12		1–5	

TABLE 3. Effect of Initial Position on Decision for Fibular Fixation

	Varus Initial Position (23 Patients)	Valgus Initial Position (30 Patients)	P
ORIF tibia with fibula fixation	6	15	0.099
ORIF tibia without fibula fixation	17	15	

of categorical data was done using the Fisher exact test. Statistical analysis between multiple variables was done using the chi-squared test. Analysis of variance testing was used for comparison between 3 or more groups of parametric data. GraphPad Prism 5 (GraphPad Software, La Jolla, CA) was used for the analysis.

RESULTS

From our university hospital database, we identified 364 patients with plafond fractures from 2004 to 2011. Of these 364 patients, 111 had high-energy nonrotational injuries with metadiaphyseal dissociation and form the basis of the study.

We identified 3 groups of patients who underwent ORIF of the distal tibia, group A: a pilon fracture with a fibula fracture that was fixed (26 patients), group B: a pilon fracture with a fibula fracture that was not fixed (37 patients), and group C: a pilon fracture without a fibula fracture (control group: 30 patients).

The average age of our entire study population was 42 years old (range, 18–85 years). There were 77 men (69%) and 34 women (31%). For the 3 groups of patients treated with ORIF of the tibia, there was no difference between the groups for patient age, sex, injury mechanism, medical history of smoking or diabetes, length of time of follow-up, or number of patients who suffered a C3 type of fracture (see **Table, Supplemental Digital Content 1**, <http://links.lww.com/BOT/A301>).

There was no difference between the fibula fracture types (oblique, comminuted, or transverse) or location of the fibula fracture between the groups of patients treated with ORIF of the tibia who had an associated fibula fracture (Table 1). However, all 25 patients (23%) with open fractures had a fibula fracture ($P = 0.004$).

A significantly higher percentage of patients with a fibula fracture were treated initially with spanning external fixation than those without a fibula fracture ($P < 0.05$). There was no difference in the use of locked plates or the total number of procedures seen between the groups (Table 2).

Fibular Fixation

Of the 26 patients who had fibular fixation, 11 were unplanned and performed at an average of 17 days after initial external fixation for inability to maintain length or alignment in the spanning frame, but before the definitive tibial fixation. The remaining 15 patients were fixed at the time of the definitive plafond management to augment fixation (6 patients), to prevent soft tissue prominence of the displaced fibula (3 patients), or to aid in reduction (6 patients). Patients with initial valgus deformity were more likely to have their fibula fixed (15/30 patients) than those presenting in varus (6/23 patients) (Table 3). Given the current number of patients, this finding was not statistically significant.

Alignment

We compared the immediate postreduction alignment, alignment at time of final follow-up appointment, and complications among these groups (Table 4). There was no difference in the postoperative reduction or its maintenance to union regardless of whether the fibula was fixed or not. Additionally, there was no difference in the postoperative or final alignment between the patients with fibula fractures [with or without fixation (groups A and B)] and those without fibula fractures (group C, $P = 0.92$). Three patients had a change in metaphyseal alignment of over 5 degrees, none of whom were in the group without fibular fixation (group B).

The total number of complications was significantly higher in the group who had their fibula fixed (group A) ($P < 0.0001$) (Table 5). The largest difference was seen in the need for implant removal. Removal was performed only after multiple visits in which the patient had complaints related to the implant that was not resolved with physical therapy. The incidence of secondary fusion and infection was similar between all groups.

DISCUSSION

Most authors agree that ORIF of pilon fractures provides the best opportunity to diminish posttraumatic arthritis and deformity.^{1,16–23} The treatment of pilon fractures with an associated fibula fracture has been traditionally approached in a staged manner with restoration of length through fixation of the fibula. We sought to evaluate whether fibular fixation was necessary to maintain alignment in patients with plafond fractures. We hypothesized that with the advent of staged protocols and the use of biplanar and locked tibial metaphyseal fixation, fibular fixation would not be needed to maintain metaphyseal alignment. We excluded rotational injuries because in these cases fibular fixation may be more valuable and safer.

Our results demonstrate that fibular fixation does not seem to be needed in the reconstruction of nonrotational pilon

TABLE 4. Average Alignment (Absolute Value) and Complication Rates by Fibular Fixation

	ORIF Tibia With Fibula Fixation (26 Patients)	ORIF Tibia Without Fibula Fixation (37 Patients)	No Fibula Fracture (Control: 30 Patients)	P
Post reduction alignment (degrees)	1.6	1.3	1.5	0.92
Alignment at union (degrees)	2.1	1.7	1.9	0.66
Alignment change >5 degrees	1 (3.8%)	0 (0%)	2 (5.4%)	0.4

TABLE 5. Complications Encountered for Patients Treated With Definitive ORIF of the Tibia

	ORIF Tibia With Fibula Fixation (26 Patients)	ORIF Tibia Without Fibula Fixation (37 Patients)	No Fibula Fracture (Control: 30 Patients)	P
Total complications	11	3	4	<0.0001
Fusion	1	0	3	0.152
Infection	3	3	0	0.085
Removal of hardware	5	0	1	0.029
Nonunion	0	0	0	NA
Compartment syndrome	2	0	0	0.155

NA, not applicable.

fractures with metadiaphyseal dissociation. In treating a pilon fracture with internal fixation, the principle of addressing the deforming force and initial angulation (varus or valgus) must be closely adhered to for optimal fracture fixation. In our series, almost half of the patients in whom the fibula was internally fixed was because translational alignment could not be held in the temporary external fixator. These patients presented with valgus angulation and lateral translation. The primary reason for the fixation was to alleviate soft tissue stress on the medial skin from the translational deformity while awaiting the soft tissues to settle allowing for definitive internal fixation.

Including implant irritation requiring removal, our data demonstrated a higher rate of complications with fibula fixation, but no added benefit in metaphyseal alignment at the time of initial reduction or at union. Therefore, the senior author now strives to avoid fibular fixation unless the initial reduction in the frame cannot be maintained, and when fixation is chosen, minimally invasive techniques are used, such as intra-medullary screws, intramedullary nails, or percutaneous plating.

The limitations of our study include its retrospective design. Two surgeons were primarily involved in the decision making, and although both followed the same general staged protocol, one used fibular fixation more liberally than the other, though this was not evaluated separately due to the small numbers. Also, a majority of the patients excluded from the study had lower energy (rotational) mechanisms. To investigate the role of fibular fixation, it was necessary to focus only on higher energy fracture patients and exclude rotational patterns. By dividing the study groups into patients with a fibula fracture who had it fixed, those who did not have it fixed, and those without a fibula fracture, we are able to compare the groups to help make definitive conclusions.

In summary, we have shown that fibular fixation may not be a necessary step in the reconstruction of pilon fractures and that fibula fixation leads to a higher rate of implant removal without any apparent benefit to metaphyseal alignment.

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