Trauma

TIBIAL PILON FRACTURES: A COMPARATIVE CLINICAL STUDY OF MANAGEMENT TECHNIQUES AND RESULTS

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ABSTRACT

Thirty-eight consecutive pilon fractures were reviewed retrospectively to compare the radiographic and clinical results with the original injuries based on three different treatment options: external fixation only, external fixation with limited internal fixation, and internal fixation only. Dates of injury were from February 1985 to February 1989. Treatment method was the surgeon's preference. The mean follow-up time was 28 months. Results were tabulated by clinical and radiographic scores. In general, simple fracture types had good results; complex ones did less well. In this study, fracture severity appeared to be the key variable in outcome.

The pilon fracture is relatively uncommon, representing only 7% of all tibial fractures. Although infrequent, it is a tremendous challenge to the orthopedist. The mechanism of injury is usually a vertical compressive force directed through the talus up into the tibia. This can result from a motor vehicle accident, a skiing injury, or a fall from height, with the degree of severity being related to the force of impact. The apparent underlying common denominator of the pilon fracture is forced dorsiflexion of the ankle. The difficulty and complexity of pilon fracture management is dependent upon the amount of associated complications which present in a variety of ways: open fracture with contamination, comminution with articular damage, disruption of the relation between tibia and fibula (the syndesmosis), compression of metaphyseal bone, or soft tissue trauma.

Rüedi and Allgöwer proposed a classification based on dislocation of the articular surface and comminution:
- Type I: no dislocation or comminution;
- Type II: significant dislocation without comminution; and
- Type III: both dislocation and comminution.

Maale and Seligson described "three basic families" of pilon fractures based on their radiologic appearance:
- distal tibial compression fractures;
- external rotatory fractures with large posterior fragments; and
- spiral fractures extending into the articular surface.

Kellam and Waddell identified two basic types of distal tibial fractures:
- Type A: the rotational pattern (less common); and
- Type B: the compressive fracture pattern.

Mast et al then grouped these concepts into the following system:
- Type I: malleolar fractures with significant

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axial load and large posterior fragments:

- Type II: spiral extension fractures; and
- Type III: central compression injuries with impaction of the talus into the distal tibia. These are further subdivided A to C using Rüedi and Allgöwer’s format.

The goal for pilon fracture treatment is to return the patient to full function. This is not easy to achieve when there is extraarticular comminution and compression of bone. The prognosis for this injury is guarded, and there are several treatment options.

Non-operative treatment consisting of closed reduction, plaster cast immobilization, and calcaneal pin traction gives poor results. Optimum repair of the articular portion of the injury demands precise anatomic reduction, which non-operative treatment cannot provide. External fixation is another proposed treatment. Good results were achieved by Hoffman et al. If combined with limited internal fixation, external fixation can effectively maintain bone length and restore the joint surface. Overall, good results have been reported with open reduction and rigid internal fixation, a treatment option outlined by Rüedi and Allgöwer. Proposed that any displaced fracture of a major weight bearing joint (ie, the ankle) should be treated in this manner unless severely comminuted.

However, internal fixation of high-grade fractures can result in considerable morbidity with malunion, loss of coverage, and osteomyelitis. Therefore, at the University of Louisville exterior fixation with or without limited internal fixation has become an option for the treatment of pilon fractures. The purpose of this article is to look at the long-term experience of treatment of these injuries.

**MATERIALS AND METHODS**

Forty-six pilon fractures from 45 patients were treated from February 1985 through February 1989. Of these, 38 fractures could be evaluated with a follow up of 12 to 57 months. The seven ankles not studied were lost to follow up after 10 months. In addition, 1 patient who underwent a primary arthrodesis 3 months after the injury because of inoperability immediately post-injury secondary to a large pulmonary embolus was excluded. These fractures were the results of motor vehicle accidents (47.4%), falls from height (31.6%), torsional injuries (13.1%), trauma (5.2%), and gunshot wounds (2.6%). Of the 37 patients, 20 were male, and 17 were female, with a mean age of 36 years (range: 16 to 59) and a mean follow-up time of 28 months (range: 12 to 57).

All 38 fractures were evaluated both clinically and radiographically. Radiographic assessment was used to determine the severity at the time of injury and the radiographic grade on the most recent radiograph. For this assessment, we used a 10-point grading scale based on the following factors: articular congruity, joint space, status of the syndesmosis, alignment of the tibial axis, fibular shortening, and compression (Table).

The clinical evaluation was based on a 10-point functional rating scale which included pain (4 points), stability (2 points), stiffness (2 points), and swelling (2 points). This gave three possible categories for patient placement: excellent (10 to 8), good (7 to 6), or poor (5 or less). Patient charts were reviewed further to find the number and type of complications, the number and type of operative procedures, and frequency of hospitalization.

Of the 13 fractures treated by external fixation alone, 6 were performed with the Hoffmann, 6 with Orthofix fixators (EBI Medical Systems, Parsippany, NJ) and 1 with an Ilizarov device. Of the 11 fractures treated with combined external and limited internal fixation, the Hoffmann device was used nine times and the Orthofixator twice for external fixation. Cancellous screws were used in seven patients for internal fixation of the tibia (four of these seven patients underwent open reduction with internal fixation of the fibula with one-third tubular plates), and two patients received an open reduction with internal fixation of the fibula only (no internal tibial fixation). Of the 14
fractures treated by internal fixation alone, 10 patients underwent open reduction and internal fixation of the tibia using single screws while four patients were stabilized with tibial buttress plates. (Five of these 14 also had fibular plating.)

**Results**

*External Fixation Only.* Closed reduction and external fixation was performed on 13 fractures, of which 5 were closed and 8 were open (1 grade I, 4 grade II, and 3 grade III). These patients were hospitalized an average of three times (range: 1 to 7) and underwent an average of five operations (range: 2 to 10). Complications were present in 85% of these cases. One patient required secondary ankle fusion 1 year later, and 10 patients required operative revision or adjustment of the external fixator. Also, in the open fractures, more infection and osteomyelitis was found, but nonunion was less frequent than in the closed fractures.

Injury radiographs scored a mean of 2.7 (range: 0 to 8) while the mean score for the most recent radiograph was 5.5 (range: 2 to 9), yielding a mean improvement of 2.8 points. The clinical evaluation was performed with a mean follow-up time of 26 months (range: 13 to 53). Results of the clinical scores were: 23% excellent, 23% good, and 54% poor, with a mean score of 5 (range: 1 to 8). Three patients (23%) had fully restored range of motion; 4 patients (31%) walked with no limp; and 5 patients (38%) still had almost no range of motion. Graphical comparison of the recent radiograph score and clinical category is shown in Figure 1.

*External Fixation and Limited Internal Fixation.* External fixation with limited internal fixation was performed on 11 fractures—5 closed and 6 open (1 grade I, 4 grade II, and 1 grade III). The patients in this group were hospitalized an average of three times (range: 1 to 7) and underwent an average of five operations (range: 2 to 13).

Complications were present in 73% of these cases. Ten patients required secondary operative procedures: 4 had revisions or adjustments of the external fixator, and 1 underwent ankle fusion. Two patients were treated secondarily with the Ilizarov system after 10 and 13 months respectively. Again, infection and osteomyelitis was present more often in open fractures than in closed fractures.

Injury radiographs scored a mean of 1.9 (range: 0 to 5) while the mean score of the most recent radiograph was 5.5 (range: 3 to 8), yielding a mean improvement of 3.6 points. The clinical evaluation was performed with a mean follow-up time of 35 months (range: 19 to 57).

**Results of the clinical scores were:**

- **27% excellent,** 18% good, and 55% poor, with a mean score of 5.2 (range: 2 to 10). Three patients (27%) had regained full range of motion, 4 patients (36%) walked with no limp, and 5 patients (45%) still had limited range of motion.

*Internal Fixation Only.* Open reduction and rigid internal fixation was performed on 14 fractures—12 closed and 2 open (both grade I). These patients were hospitalized an average of 1.7 times (range: 1 to 3) and underwent an average of 2 operations (range: 1 to 4). Complications were present in 43% of these cases. Three patients required secondary operative procedures, one had revision for greater stability at 1 month, and one nonunion elected below-knee amputation. Infection and osteomyelitis were not found in these cases, but three patients did have initial wound problems.

Injury radiographs scored a mean of 5.1 (range: 1 to 8) while the mean score of the most recent radiograph was 8.3 (range: 6 to 10), yielding a mean improvement of 3.2 points. The mean follow-up time for clinical assessment was 23 months (range: 12 to 39), and the results were: 57% excellent, 29% good, and 14% poor, with a mean score of 7.2 (range: 2 to 9). Three patients (21%) had full range of motion, 11 patients (79%) walked with no limp, and 3 patients (21%) had little range of motion.

**Discussion**

The pilon fracture can be problematic for the physician: not all may be treated success-
Fig 2: Radiograph of a 26-year-old man who sustained a right, grade II open pilon fracture in a motor vehicle accident (A). This was scored as 3 points. Hours after injury and post-application of the external fixator, severe comminution and bone loss are seen (B). The patient underwent bone grafting 12 days later to fill the metaphyseal defect, and after 37 months, the radiograph score improved to 6 points. The clinical outcome for this patient was poor (C).

Fig 2B.

Fig 2A.

Fig 2C.

fixation group in our study showed 86% good to excellent results upon the clinical evaluation, but these were simple fractures in 86% of the cases, with a mean injury radiograph score of 5.1 points. Use of the comprehensive fracture classification, which purportedly groups fractures according to increasing severity, does not address the pilon fracture adequately because it does not account for the relationship between tibia, fibula, and talus at the mortise. A fracture grouped as “A” (Figures 2A-C) may be a more severe injury than a fracture grouped in “B” or “C” (Figures 3A-C).

In more severe fractures, the cartilage can be damaged beyond repair or the joint surface can be so severely comminuted that small fragments will be difficult to recognize, making reconstruction of the joint surface impossible. The difficulty involved in attaining stable fixation from open operative treatment is a reason to opt for an indirect method of treatment such as external fixation.

An approach to these more severe fractures is to use external fixation. In the external fixation group, good to excellent results were found in 46% of the cases, with 62% of these fractures being open. Using this treatment option, the mean radiograph score jumped from an injury score of 2.7 to the most recent score of 5.5, showing an increase of 2.8 points. This is significant with respect to the severity of injuries involved.

In conclusion, the pilon fracture is an uncommon and difficult fracture to manage. Many believe open reduction and internal fixation should be the treatment of choice for most pilon fractures. A detailed analysis of a prospective series of fractures of comparable severity will be required to determine which treatment option is best. At present, we believe that simple fractures...
are best managed with internal fixation while complex fractures should be placed in external fixation.

REFERENCES


