

## Clinical Study

# Treatment of Tibial Pilon Fractures

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**Abstract:** The authors reviewed the clinical results and problems of 11 tibial pilon fractures in 11 patients (average age 55 years). The post-operative follow-up period averaged 18 months (range 3 - 38 months). The cause of injury in 7 of the cases was motor vehicle accidents. All fractures were closed. According to the AO classification, five fractures were Type B1, 1 was Type B2, 2 were Type C2, and 3 were Type C3. Using the clinical evaluation standards of Burwell and Charnley, 4 out of the 5 Type C2 and C3 cases were graded fair according to both the objective and subjective criteria, and the results of severe cases were poor irrespective of therapies given. The clinical results of these fractures tend to be influenced by the type of fracture. In severe types, therefore, external fixation with minimal internal fixation and early range of motion exercise is beneficial.

**Key words:** Pilon fracture, Operative treatment, Internal fixation, External fixation

## INTRODUCTION

Pilon fractures are fractures of the distal metaphysis of the tibia that involve the weight bearing articular surface of the ankle joint. These fractures are relatively rare, constituting only 7 % of all tibia fractures and less than 1 % of all lower extremity fractures<sup>1)</sup>. Many of these fractures result from high-energy injuries such as vehicular trauma or falls from heights. The weight-bearing surface of the tibia is comminuted in many cases and it is usually impacted upwards into the cancellous bone of the tibial metaphysis. Therefore, surgeons often find it difficult to perform anatomical reduction or stable fixation. This study reviews the clinical results and problems of pilon fracture treatment.

## PATIENTS AND METHODS

Eleven patients (10 male and 1 female) with 11 pilon fractures were treated. The age of the patients ranged from 37 to 80 years, with a mean age of 55 years. The follow-up period was 8 to 38 months with a mean of 18 months. Seven patients had injured their ankles in motor vehicle accidents, and four by falling. All of the fractures were closed. According to the AO (Arbeitsgemeinschaft für Osteosynthesefragen) classification<sup>2)</sup> (Fig. 1), 5 fractures were Code 43 Type B1, 1 was Type B2, 2 were Type C2, and 3 were Type C3. The fibula was fractured in 9 of the 11 cases. Of these patients, six were treated by open reduction and internal fixation, two by external fixation in combination with internal fixation and one fracture was treated with an external fixator only. Two patients were treated non-operatively by calcaneal pin traction and plaster cast immobilization. The

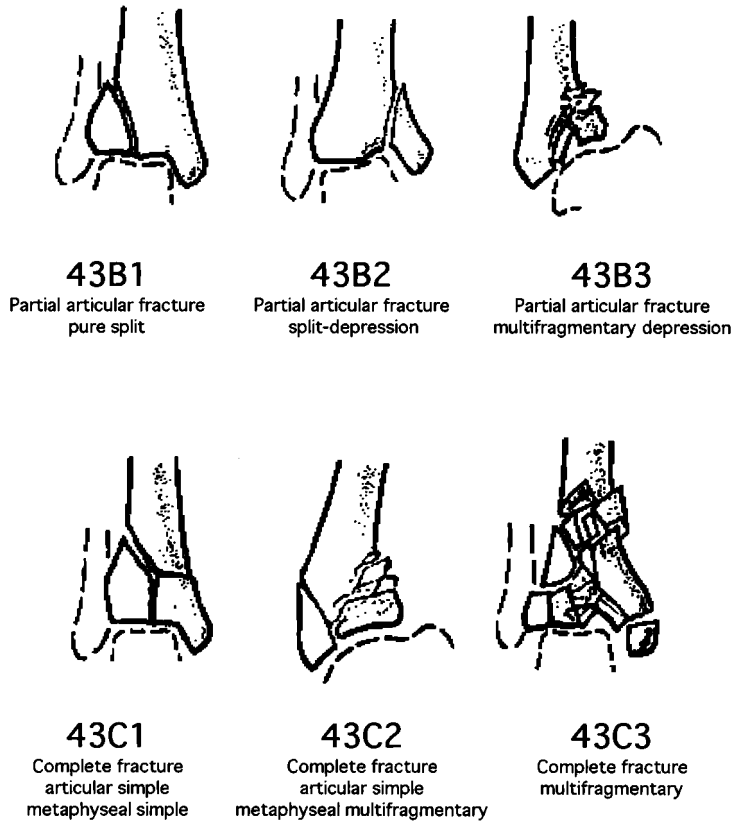


Fig. 1 AO classification of tibial pilon fractures.

final clinical results were graded good, fair, or poor and subdivided into subjective and objective results using the criteria of Burwell and Charnley<sup>3)</sup> (Table 1).

#### RESULTS

Overall results were good in 6 cases and fair in 5 cases according to the objective criteria. Under the subjective criteria, the results were good in 7 cases and fair in 4 cases. There were no poor cases. The clinical results according to the objective criteria for treatment and fixation methods in each fracture type were as follows (Table 2). All 5 cases of Type B1, with no comminution at the fractured part, were treated by

internal fixation with screws or plates and the results were good. Internal fixation was performed on the only case of Type B2, but the results were fair. Both cases of the more severe Type C2 each received external fixation and non-operative treatment with a cast. For Type C3, 1 case was treated non-operatively using a plaster cast, while internal fixation with a plate was used in combination with external fixation for the remaining 2 cases. The results were fair in 4 out of these 5 Type C2 and C3 cases.

#### CASE REPORTS

*Case 1:* A male, aged 48 years, sustained injuries in a head-on collision with a truck whilst

Table 1. Objective and subjective criteria of clinical assessment

Objective criteria	
Good	Ankle and foot movements at least three-quarters normal, trivial swelling, normal gait
Fair	Ankle and foot movements at least half normal, small amount of swelling, normal gait
Poor	Ankle and foot movements less than half normal, swelling, any visible deformity of ankle or foot, limp
Subjective criteria	
Good	Complete recovery apart from possible slight aching after use
Fair	Aching during use, slight stiffness (not enough to interfere with work), ability to walk not seriously impaired
Poor	Any serious impairment of ability to work or walk, pain

Table 2. Outcomes of treatment according to objective criteria

Type of fractures Method of treatment	B1		B2	C2		C3	
	ORIF with screw	ORIF with plate	ORIF with plate	EF	Cast	ORIF with plate and EF	Cast
Good	3	2				1	
fair			1	1	1	1	1
poor							

ORIF: Open Reduction and Internal Fixation EF: External Fixation

driving a car. Radiographs on admission revealed a comminuted fracture of the right tibial metaphysis (Fig. 2-A). The fracture was classified as Code 43 Type C2 according to AO classification. The joint surface was in the 22° valgus deformity against the tibial axis. Additionally, he had fractures of the ribs, acetabulum, radius and femur as well as concurrent perforation of the small intestine and colon. The patient was placed in calcaneal pin traction. When general conditions improved 24 days later, an Orthofix articulated external fixator for the ankle joint was applied.

Postoperative radiographs revealed no shortening at the fractured part and valgus deformity had been well corrected (Fig. 2-B). At four months after the operation, bone union was complete and the external fixator was removed. Weight bearing walking was begun with the brace attached. At the time of the final observa-

tion 10 months after the operation, the range of motion of the ankle was 5° dorsiflexion and 40° plantar flexion, with no deformity in appearance and no ankle joint pain (Fig. 2-C).

*Case 2:* A male, aged 56 years, fell from a height of 2 m while working at a construction site. Radiographs on admission revealed a Code 43 Type C3 pilon fracture of the tibia (Fig. 3-A). The injury was treated surgically 10 days after being placed in calcaneal pin traction. After plating the fibula, the tibial articular surface was reduced under direct visualization. Screws and plates provided permanent fixation and bone grafting to the metaphyseal defect was performed. Additionally, fixation with an Orthofix articulated external fixator was applied after closing the wound (Fig. 3-B). Exercises for range of motion of the ankle joint were begun on the 5th postoperative day, and partial weight bearing began from 8 weeks after surgery. At 14

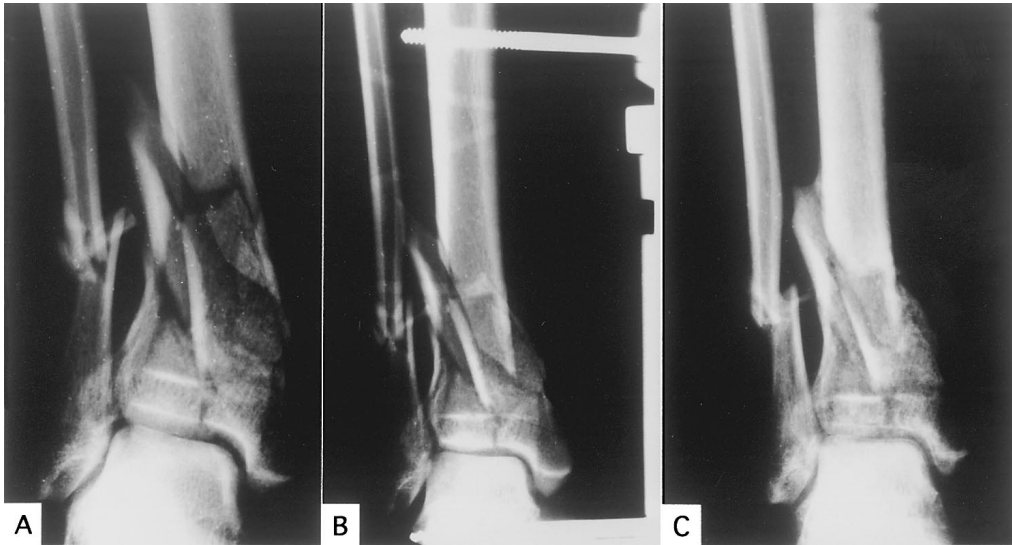


Fig. 2 Case 1: A 48-year-old male, (A) pre-operation, (B) post-operation, (C) 10 months after operation.

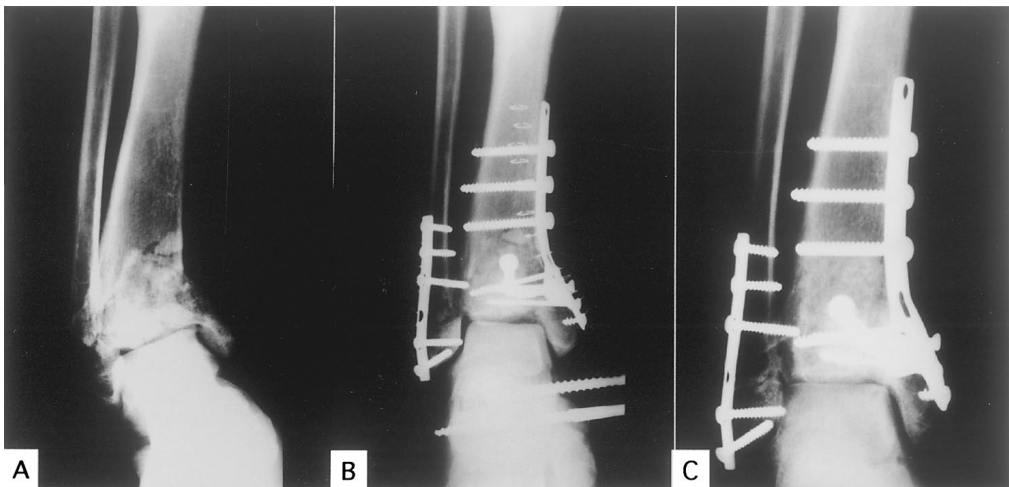


Fig. 3 Case 2: A 56-year-old male, (A) pre-operation, (B) post-operation, (C) 13 months after operation.

weeks after surgery, the external fixator was removed and full weight bearing walking was allowed. At 13 months after surgery, the patient has no pain, no limited range of motion and no limping (Fig. 3-C).

#### DISCUSSION

As pilon fractures are caused by a strong

external force, the articular surface is comminuted in many cases and severe swelling and circulatory disorder of the skin can be observed. Moreover, it is difficult to see the entire articular surface during the operation, making it difficult in some cases for surgeons to perform accurate reduction and rigid fixation. As with other intra-articular fractures, treatment is in principle based on the anatomic reduction of the

articular surface, stable fixation and early active range of motion. Ruedi and Allgower<sup>4)</sup> have stated that restoration of the anatomic length of the fibula, reconstruction of the tibial articular surface, cancellous bone grafting of the metaphyseal defect, and support of the medial aspect of the tibia are important when operating, recommending fixation with plates. Scheck<sup>5)</sup> emphasizes treating pilon fractures by dual-pin fixation combined with limited open reduction by reconstructing the articular surface through a small skin incision without stripping the soft tissues. DiChristina *et al.*<sup>6)</sup> have maintained that medial support of the tibia is accomplished by a medial external fixator with an articulated ankle hinge instead of a medial plate. This avoids the soft tissue dissection necessary to apply the plate and enables reconstruction of the articular surface and bone grafting through limited exposures, again preserving the soft tissues. Bonar and Marsh<sup>7)</sup> have noted that, in comparison with internal plate fixation, applying the articulated body of the Orthofix external fixator to pilon fractures provides certain advantages: there are less complications, the articular surface can be well preserved and articular movements can be made with the fixator attached. Kim *et al.*<sup>8)</sup> have claimed that the combined use of a ring fixator and arthroscopy is a safe and effective treatment for this fracture.

In the present study, good results were obtained for Type B1 fractures, in which surgery by internal fixation with screws and plates can be performed. However, fair results were obtained for two cases each of Types C2 and C3 with comminuted fractures. Of these, 3 cases were treated conservatively by external fixation only, without reduction of the articular surface. Good results were achieved one other case in which it was possible to reduce the articular surface. Judging from the results of this study and

therapies described in the literature, we considered the following to be appropriate operative principles.

- (1) The firmest possible internal fixation is applied to Types B1 and C1 in which the skin condition is good and the articular surface is free of comminution and depression.
- (2) After reduction of the articular surface, rigid internal fixation with bone grafting of the bony defect is performed in Types B2 and B3.
- (3) For cases in which either the skin condition is bad or with severe comminution and depression of the articular surface, particularly Types C2 and C3, reduction of the articular surface and bone grafting of the bony defect are performed, and external fixation is used in combination with limited internal fixation. Additionally, reduction of the articular surface under an arthroscopy is considered necessary for Type C3, which is characterized by a severely comminuted articular surface. Combined use of external fixation for severely comminuted cases of Types C2 and C3 was considered to be one useful fixation approach.

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