

Analysis of the Operative Treatment for Pilon Fracture

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ABSTRACT

Background: Pilon fracture is common clinical joint fracture and difficult to treat. It has high requirements on reduction and fixation. The selection of treatments is challengeable. In order to recover the ankle function maximize, there are many treatments proposed in paper recently, but no further studies. Therefore, patients of our hospital with Pilon fracture were followed up and the treatments were compared by different operations.

Materials and methods: Eighty-eight patients from August 2003 to October 2010 treated with conservative treatment, open reduction and internal fixation, external fixation combined with limited open reduction and internal fixation and external fixation were retrospectively analyzed.

Results: Seventy-eight cases were followed up in 88 patients, 66 cases were treated with operation. Postoperative complications: malunion in 7 cases, wound infection and delayed healing in 5 cases, delayed union in 2 cases and traumatic arthritis in 4 cases. At the same time, ankle function of type III Pilon fracture after operation was scored by Tornetta.

Conclusion: Choose a suitable operation style and time according to Pilon fracture type and degree of soft tissue and use external fixator combined with limited internal fixation for fracture reduction properly, a good clinical effect can be achieved after surgery.

Keywords: External fixation, Limited internal fixation, Pilon fracture.

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INTRODUCTION

Pilon fracture is also known as distal tibia plateau fracture or distal tibial fracture. It is a complex fracture by which complications will easily be induced and the treatment is very difficult. For Pilon fracture, no single method can obtain an effective result and different treatments also have different emphasis and scheme selection.

The clinical data of 78 cases with pilon fracture were analyzed retrospectively from August 2003 to October 2010.

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MATERIALS AND METHODS

General Materials

Seventy-eight cases of Pilon fracture patients include 50 males and 28 females aging between 18 and 57 years old. Injury causes: 27 cases as falling from high altitude, 27 cases as traffic accident, 13 cases in crush injury, 4 cases in grinding contusion and 7 cases in muscle strain. Comorbidity: systemic composite injury in 2 cases, spinal fracture in 2 cases, pelvic fracture in 2 cases, upper extremity fracture in 2 cases, fibula fracture in 54 cases, calcaneus fracture in 4 cases.

According to Rüedi-Allgöwer classification: type I in 5 cases, type II in 21 cases and type III in 52 cases. Treatment: 12 cases with conservative treatment and 66 cases with operation. Among the 66 cases, 54 cases were treated with open reduction and internal fixation: 32 with early open reduction and internal fixation, 22 with delayed open reduction and internal fixation; 8 with limited internal fixation combined with external fixation, of which 4 cases were treated with the external fixator + tibia limited open reduction and internal fixation, 2 cases with external fixator + internal fixation of fibula + limited open fixation of tibia, 2 cases with external fixator + internal fixation of fibular; 4 cases with external fixation. Post-operative complications were found in the type III Pilon fracture: 4 cases with wound dehiscence, 1 case with infection, 5 cases with malunion, 2 cases with delayed union, 2 cases with post-traumatic arthritis.

Surgical Method

Cases treated with open reduction and internal fixation were divided into three groups: early open reduction and internal fixation and delayed open reduction and internal fixation according to the operation time before or after 1 week after injury.

1. *Early open reduction and internal fixation:* It is suitable for type I, type I Pilon fracture and lighter type II Pilon fracture were generally carried out in 1 week after the injury. First fibula length was restored with open reduction and internal fixation; incision was adopted at lower shank by front and medial tibial to show lower tibial fracture and ankle; internal fixation of distal tibial fractures; pay attention to keep the soft tissue of the fracture. Metaphyseal bone grafting was carried out if articular surface subsidence occurred.
2. *Delayed open reduction and internal fixation:* It is applied to type II Pilon fracture or significant soft

tissue swelling and generally carried out in 7 to 14 days after injury. Preoperative plaster support or transcaneal traction was proceeded to fix the fracture while open reduction and internal fixation was proceeded after the regression of swelling and distension.

3. *External fixation combined with limited internal fixation:* It is applied to severe type III Pilon fracture which has severe soft tissue injury, local tension vesicle and even osteofascial compartment syndrome or local contamination of open fractures is too serious to process 1st stage operation. After the improvement of the soft tissues, fibula fracture was processed with open reduction and internal fixation and external frisket draft fixing. According to pathogenetic condition, we choose a suitable skin incision on front and inside of the shank to process reduction fixation of distal tibia and articular surface after maintain the tibial length and axial line. If distal tibial comminution is severe, it is treated with internal fixation and external fixation. It is considered unsuitable for 1st stage bone grafting when the comminution is severe, soft tissue swelling is significant or open fractures.

Ankle Function Score and Statistical Treatment

The high complication rate of type III Pilon fracture influences the ankle much, so the incidence rate of postoperative complications and ankle joint were compared and evaluated. Postoperative function of ankle joint was assessed by the Tornetta (1993) scoring model which includes pain, range of motion of the ankle and angular deformity or not. Samples of group treated with open reduction and internal fixation and group treated with delayed open reduction and internal fixation of type III Pilon fracture was statistically treated with SPSS 13.0. Rank sum test was adopted to compare one-way ordinal data while Chi-square test was adopted to compare the rate of sample.

RESULTS

All 78 cases were followed up for 6 to 12 months. Type I and light type II Pilon fracture postoperative results were fine. The incidence of the postoperative complications of severe type II and type III Pilon fracture is high and the function of ankle joint is poor. Fifty-two in 78 cases were type III Pilon fracture and statistical analysis was processed.

Postoperative Complications

Wound infection and delayed union in 5 cases, fracture delayed healing in 2 cases, malunion in 7 cases, traumatic ankle arthritis in 4 cases. Comparison of postoperative complications and ankle function score is shown in Tables 1 and 2.

From Table 1, the difference of postoperative complications of group early open reduction and internal fixation and group delayed open reduction and internal fixation was statistically significant ($\chi^2 = 4.813$, $p < 0.05$). Incidence rate of complications of early open reduction and internal fixation is higher than delayed open reduction and internal fixation.

In Table 2, the difference of ankle joint function of group early open reduction and internal fixation and group delayed open reduction and internal fixation was statistically significant by Wilcoxon test ($U = 256$, $p < 0.05$). Ankle functional rehabilitation of group open reduction and internal fixation is superior to group external fixation combined with limited internal fixation.

DISCUSSION

The Pilon fracture is a kind of high energy injury which has characteristics as follows: juxta-articular comminuted fracture of the distal tibial, collapse of articular surface, combined with Pott's fracture and severe soft tissue injury. It would affect medial malleolus, lateral malleolus and hock. The high instability, primary injury of the articular cartilage and the permanent irregularity on the surface joint often leads to adverse prognosis. Due to poor blood supply of distal shank and soft tissue coverage, it is prone to skin necrosis and nonunion post injury.

The Rüedi-Allgöwer Classification of Pilon Fracture (Fig. 1)¹

Type I: Nondisplaced cleavage fracture, the fracture line extends to the distal tibial articular surface (no obvious shifting);

Type II: Moderate splinter of distal tibial and moderate malalignment of articular surface (obvious shifting but no splinter on articular surface);

Type III: Severe splinter of distal tibial and malalignment of articular surface (distal tibial comminuted compression fracture).

Table 1: Comparison of postoperative complications of two groups of type III Pilon fracture (cases)

Group	No compli- cations	Compli- cations	Sum	Rate (%)
Early open reduction and internal fixation	8	6	14	42.86
Delayed open reduction and internal fixation	22	3	25	12
Sum	30	9	39	23.08

Table 2: Comparison of ankle function score (cases)

Group	Excellent	Good	Bad	Excellent rate (%)
Open reduction and internal fixation	27	8	5	67.5
External fixation combined with limited internal fixation	5	4	3	41.67



Fig. 1: Rüedi-Allgöwer's classification of Pilon fractures (1969)

Postoperative Complications

Tibial was located in the subcutaneous and it is vulnerable to trauma; the lower leg is peripheral blood supply and has poor soft tissue coverage which leads to weak healing. As a kind of high energy injury, especially heavy type III Pilon fracture, because of its severe soft tissue injuries or open fractures, it is unable to carry out operation or forceful internal fixation early. If an operation is processed, it is prone to skin necrosis, wound infection and delayed wound healing which cause delayed union and nonunion, malunion, increase traumatic arthritis, influence the effect of operation. Among 52 cases, there were infection and delaying of skin flap in 5 cases, malunion in 7 cases, delay union in 2 cases and traumatic arthritis in 4 cases.

Operation Time

The fracture type and the degree of soft tissue injury are two important factors which influence prognosis.² For type I Pilon fracture and type II Pilon fracture with light soft tissue injury, in order to recover anatomical position of ankle joint utmost, operation should be processed as early as possible. For heavy types II and III Pilon fracture, or open Pilon fracture, early operation will aggravate soft tissue injury and destroy blood supply to the fracture ends. Delayed operation can effectively reduce or avoid soft tissue complications and improve soft tissue conditions. Kalenderer³ argues high soft tissue complications have a relationship with emergency operation treated with open reduction and internal fixation. Delay operation time until the soft tissue 'safe' can reduce the incidence of complications. Table 1 shows that early operation has a higher rate of soft tissue complications than delayed operation of type III Pilon fracture. Therefore, it is assumed that in order to recover ankle anatomy, fracture with severe soft tissue injuries, open fracture or tension vesicle should be treated with internal fixation of fibula and limited internal fixation of tibia based on external fixation after improving the soft tissue.

Choice of Surgical Treatments

A suitable surgical treatment is important to the prognostic of Pilon fractures. Patients of types I and II Pilon fracture with no surgical contraindication and light soft tissue injury should be processed open reduction and

internal fixation as soon as possible. Patients of types II and III Pilon fracture with severe soft tissue injury should be performed operation later to reduce skin necrosis and infection rate. The treatment of complex, open or severe soft tissue injury Pilon fracture is more difficult. There is no single treatment can obtain satisfactory curative effect, the clinical therapies was diversity. If the patients with type I Pilon fracture are surgical contraindication or displacement fracture are not obvious, expectant treatment can be carried out. The severe types II and III Pilon fracture should be processed operation as possible. Operation treatment included open reduction and internal fixation; external fixation combined limited internal fixation and external fixation, etc.

- *Open reduction and internal fixation:* Open reduction and internal fixation can make the fracture to achieve or approach anatomic reduction. Types I and II Pilon fracture with low energy trauma and light soft tissue injury treated with open reduction and rigid internal fixation can start the postoperative passive ankle joint function exercise early. After improving soft tissue conditions type III Pilon fracture should be treated with open reduction and rigid internal fixation as soon as possible. Pugh⁴ covered that among 60 cases of tibial Pilon fracture, 24 cases were treated with open reduction and internal fixation which has lower malunion than those with single external fixation. In this paper, 66 in 78 cases were processed operation and 52 cases were type III Pilon fractures. Table 2 shows that ankle joint function group of open reduction and internal fixation was much better than group external fixator combined internal fixation, but higher complications remains demerit (Figs 2A and B).
- *External fixator combined limited open reduction and internal fixation:* This is applied in high energy types II and III Pilon fractures which are often accompanied with severe soft tissue injury. Open reduction and internal fixation aggravates soft tissue trauma and increase wound complications. Therefore, experts choose application of external fixation, or external fixation combined with fibular fracture fixation, or external fixation combined with fibular fracture with internal fixation of distal tibia limited open reduction and internal fixation to reduce or avoid wound complications effectively. But the fracture is fixed indirectly by the operation above and the microinching of joint



Figs 2A and B: (A) Pilon fracture and (B) 4 weeks after Pilon fracture operation

causes delayed union or nonunion. Long-playing ankle joint immobilization is needed after operation which is easy to cause ankylosis. Fracture treated with external fixator combined with limited open reduction and internal fixation is relative stability which is convenient for ankle early passive activity and helpful for the functional recovery of ankle joint. It is a sound therapeutic method for the heavier type II and III Pilon fracture.⁵ Patterson⁶ reported that the excellent rate of 18 patients with types II and III Pilon treated with blended external fixator combined with limited internal fixation was 83%. Okcu⁷ retrospectively analyzed 60 cases of Pilon fracture patients and concluded that external fixation combined with limited internal fixation got a good curative effect. In this paper, 8 cases treated with external fixation combined with limited open reduction and internal fixation was followed up and their postoperative outcomes were satisfactory.

- *Simple external fixation:* It is applied in patients with severe type III Pilon fracture, combined fibular comminuted fracture, severe soft tissue injury, or severe compound systemic injury. Because fixation time is long and blood supply of soft tissue is bad, postoperative complications are as follows: ankylosis, delayed union or nonunion, and bad functional rehabilitation.

Role of Internal Fixation of Fibula in Tibiofibula Fracture

In recent years, fixation of fibula in tibiofibula fracture has been attached increasing importance.⁵ For type III Pilon fractures, comminution of distal tibia is severe and the end of fracture cannot be firmly fixed by simple external fixator which would cause microinching and nonunion and delayed union. At the same time, because of tibial fracture collapse, it is difficult to resist the muscle musculotendinous contracture by external fixation and distal tibia is easy to detach to back talus. In the clinical

treatment, we find that external fixation combined with fibular fixation cannot only regain limb length and support fracture after the fibular is stable, but also set a benchmark for tibial fracture reposition. It would simplify the operation procedure, increase fracture fixation stability and reduce the rate of delayed union and nonunion. The importance of fibula internal fixation in Pilon fracture was emphasized by Rüedi¹ in 1979.

In short, type of Pilon fracture and degree of soft tissue injury are two main factors which affect curative effect of tibial Pilon. Operation timing and choice of treatment protocols play an important role in treatment and prognosis. For types II and III Pilon fracture, patients should be processed open reduction and internal fixation later if emergency operation cannot carry out in 8 to 10 hours. For severe type III Pilon fracture, external fixation combined with limited internal fixation cannot only stabilize the fracture, but also can reduce the postoperative complications. In the treatment of Pilon fractures, fibular internal fixation has a significant role on the recovery of limb length, tibial fracture apposition and fracture stability.

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