APPLICATION AND EFFICACY ANALYSIS OF LLIZAROV EXTERNAL FIXATOR IN THE TREATMENT OF TYPE II PILON FRACTURE

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ABSTRACT

Objective*: The purpose of the study was to investigate the therapeutic efficacy and application value of Llizarov external fixator in the treatment of type II Pilon fracture.*

Methods: *A total of 100 patients with type II Pilon fracture admitted to the orthopaedics department of our hospital from February 2017 to June 2019 were selected and their clinical data were retrospectively analyzed, and according to different surgical methods the patients were divided into 2 groups, group A and group B, with 50 patients in each group. Among them, group A patients received Llizarov external fixator, while group B patients were treated with delayed open reduction and internal fixation. After that, operation duration, intraoperative blood loss, the incidence of adverse reactions, ankle pain score, ankle activity score as well as the recovery of fracture sites of the patients were compared between the two groups, so as to analyze the clinical significance of the Llizarov external fixator.*

Results: *The operation duration and intraoperative blood loss of the patients in group A were significantly lower than those in group B, with statistical significance (P<0.05); the incidence of adverse reactions of the patients in group A was significantly lower than that in group B, with statistical significance (P<0.05); the ankle pain score and ankle activity score of the patients in group A were significantly higher than those in group B, with statistical significance (P<0.05); the recovery of fracture sites of the patients in group A was significantly better than that in group B, with statistical significance (P<0.05).*

Conclusion: *Treatment with Llizarov external fixator can significantly reduce operation duration, intraoperative blood loss and the incidence of adverse reactions, improve ankle function and promote the recovery of fracture sites in patients with type II Pilon fracture; therefore the Llizarov external fixator has high application value in the treatment of type II Pilon fracture.*

Keywords: *Llizarov external fixator, type II Pilon fracture, therapeutic effect, ankle function.*

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Introduction

Pilon fracture refers to the fractures which involve metaphysis and articular surface of distal tibia, that which is mostly manifested by open injuries, with less articular cartilage damage. According to the severity of fracture, Pilon fracture can be specifically classified into 3 types, type I, II and III. Type I mainly refers to fractures occurring in the articular surface of distal tibia, and for this type of fracture has less displacement, recovery can be realized by only conservative treatment; type II is mostly characterized by more displacement and less fracture comminution of the articular surface, so the surgical fixation of fracture sites is required[1-3]; the patients with type III Pilon fracture who mainly present with severer fracture displacement and comminution in articular surface should be treated with surgery combined with corresponding fixation in fracture sites. Regular damages of Pilon fracture

to the surrounding soft tissues due to their thinness and insufficient blood supply may require longer recovery time after open surgery, and this surgical approach can easily lead to patients' permanent disability[4-6]. At present, the surgical methods for Pilon fracture in clinical practice mainly include open reduction and internal fixation, limited open reduction and internal fixation combined with external fixator, delayed open reduction and internal fixation, etc., with each one having their own advantages and drawbacks. Llizarov circular external fixator, with the advantages of the omission of angulation, rotation and lateral displacement, can be adjusted in all directions and provide strong stability, and it has been widely applied in clinical treatment of limb orthosis, osteomyelitis, limb lengthening, etc.[7-9].

In this study, in order to investigate the therapeutic effect and application value of the Llizarov circular external fixator in the treatment of type II Pilon fracture, the relation between the implementation of the Llizarov circular external fixator and the operation duration, blood loss, the recovery of fracture sites as well as the incidence of adverse reactions was analyzed. Specific study results are reported as follows.

Materials and methods

General information

A total of 100 patients with type II Pilon fracture admitted to the orthopaedics department of our hospital from February 2017 to June 2019 were selected and their clinical data were retrospectively analyzed, and according to different surgical methods the patients were divided into 2 groups, group A and group B, with 50 patients in each group.

The age of the patients ranged from 25 to 42 years old in group A and from 23 to 44 years old in group B. There were no significant differences in the general information such as gender, age, injury manner, etc. between the two groups, with no statistical significance in study results (P>0.05), as detailed in Table 1.

Inclusion/exclusion criteria

Inclusion criteria:

• Patients had the clinical symptoms of type II Pilon fracture;

• Patients aged 18 years and above;

• Patients had no blood coagulation disorders and did not take anticoagulants recently;

• Patients had no history of drug allergy, drug abuse and bad addiction;

• This study was approved by the Hospital Ethics Committee, and the patients all voluntarily participated in the study and signed the informed consent.

Exclusion criteria:

• Patients had severe fractures in the rest of the body;

• Patients had the disturbance of consciousness and could not cooperate with the study;

• Patients received other surgeries recently.

Group		Group A	Group B	X^2/t	P
Gender (Male/Female)		31/19	30/20	0.04	0.84
Age (years old)		36.22±4.40	36.58±4.37	0.41	0.68
Height (cm)		174.48±7.03	174.39±7.26	0.06	0.95
Weight (kg)		71.35±4.49	70.93±5.00	0.44	0.66
Smoking history (years)		4.41±1.06	4.55±1.21	0.62	0.54
Drinking history (years)		6.88±1.76	6.80±1.69	0.23	0.82
Injury manner	Injury by fall from height	4	5	0.12	0.73
	Traffic accident	13	10	0.51	0.48
	Injury by crushing	11	14	0.48	0.49
	Falling down	22	21	0.04	0.84

Table 1: Comparison of the general information between the two groups ($\bar{x}\pm s$).

Methods

After all the patients underwent routine examinations before surgery, group A patients were treated with Llizarov external fixator. During surgery, the patients, with supine positions, were given epidural anesthesia, and regular disinfection should be performed in the event of open injuries in the fracture sites. Then, the fixator was placed in anterior medial tibia by 2 screws, puncturing cortical bones on both sides, and meanwhile the fixator was also fixed to the talus and calcaneus, with keeping the screws parallel to the articular surface and avoiding major arteries and nerves[10-12].

Group B patients underwent delayed open reduction and internal fixation, which included two stages, stage I and stage II. In stage I, external fixator or calcaneal traction was adopted temporarily to realize fracture reduction and prevent further damage to soft tissues. After the soft tissues stabilized in stage II, the open reduction and internal fixation was performed. During surgery, a straight incision in posterior lateral malleolus was made to fully expose

the fracture sites and perform the fracture reduction with screws fixed in distal tibia. If the patients had joint injuries, the joint reduction should be conducted and fixed with screws. Additionally, the C-type arm was used to provide the proper position to place the screws on the calcaneus and tibia, and then the screws were connected with the fixator.

Observation indexes

Operation duration, intraoperative blood loss, the incidence of adverse reactions, ankle pain score, ankle activity score as well as the recovery of fracture sites of the patients were compared between the two groups. In ankle pain scoring, with the total score of 50 points, 0-19 points represented severe, intense and persistent pain, 20-29 points recurrent severe pain, 30-39 points occasional and bearable pain and 40-50 points no pain. In ankle activity scoring, with the total score of 10 points, 0-3 points represented severe limitation in daily and recreational activities, with the requirement of go-cart, walking stick, wheelchair and bracket, 4-6 points the limitation in daily and recreational activities, with the requirement of walking stick, 7-9 points only limitation in recreational activities, with the requirement of walking stick and 10 points no limitation in daily activities, with no requirement of suppor[t(13-14)]. The recovery conditions of fracture sites were mainly evaluated by osteophyte volume and callus density, which were the main indexes used in iconography. 0 represented obvious fracture sites and no growth of callus, 1 point the blur fracture sites and the growth of callus with low density, 2 points increased callus density and darkening callus and 3 points the consistent callus color with the normal one.

Statistical treatment

The selected data processing software for this study was SPSS20.0, and GraphPad Prism 7 (GraphPad Software, San Diego, USA) was used to draw the pictures of the data.

Measurement data were expressed by ($\bar{x}\pm s$) and tested by t-test. Enumeration data were expressed as [n (%)] and tested by X^2 test. The differences had statistical significance when $P<0.05$.

Results

Comparison of operation duration and intraoperative blood loss between the two groups

The comparison of operation duration and intraoperative blood loss between the two groups showed that the operation duration and intraoperative blood loss of the patients in group A were significantly less than those in group B, with statistical significance ($P<0.05$), as shown in Table 2.

Group	Operation duration (min)	Intraoperative blood loss (ml)
Group A	63.28±11.39	109.26±7.74
Group B	75.59±12.00	120.09±8.65
t	5.26	6.60
P	<0.001	<0.001

Table 2: Comparison of operation duration and intraoperative blood loss between the two groups ($\bar{x}\pm s$).

Comparison of the incidence of adverse reactions between the two groups

The adverse reactions occurring in patients in this study included surgical incision infection, fracture site infection, pin track infection, vascular injury and nerve injury in ankle, and the comparison revealed that the incidence of adverse reactions in group A was 8%, which was significantly less than that of 36% in group B, with statistical significance ($P<0.05$), as shown in Figure 1.

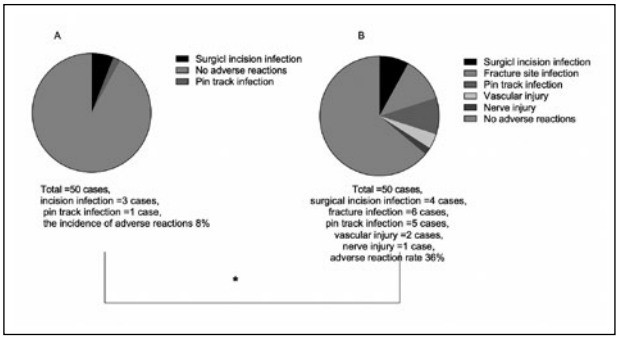

Figure 1: Comparison of the incidence of adverse reactions between the two groups.

*Note: Figure A represented the incidence of adverse reactions in group A, with 3 cases of surgical incision infection and 1 case of pin track infection, and the incidence of adverse reactions was 8%. Figure B represented the incidence of adverse reactions in group B, with 4 cases of surgical incision infection, 6 cases of fracture site infection, 5 cases of pin track infection, 2 cases of vascular injury and 1 case of nerve injury, and the incidence of adverse reactions was 36%. *indicated that there were statistically significant differences in the incidence of adverse reactions between the two groups, $X^2=11.42$, $P=0.001$.*

Comparison of ankle pain score between the two groups

The comparison of ankle pain score between the two groups indicated that the ankle pain score in group A was significantly higher than that in group B, with statistical significance ($P<0.05$), as detailed in Figure 2.

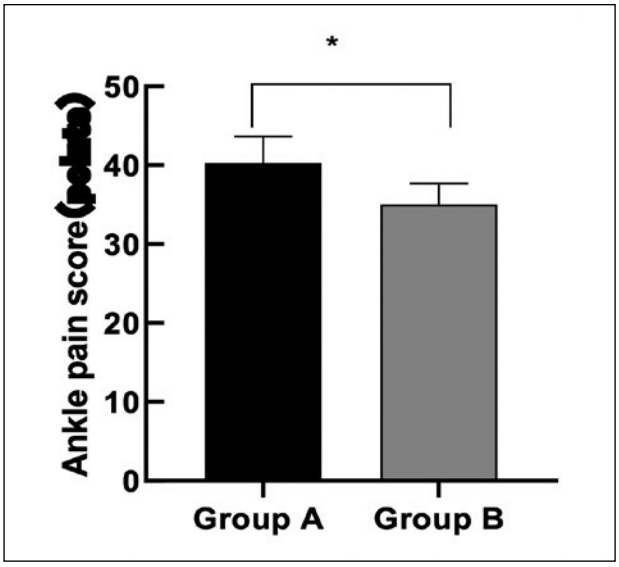

Figure 2: Comparison of ankle pain score between the two groups.

*Note: The abscissa represented group A and group B, while the ordinate represented ankle pain score. *indicated that the comparison of ankle pain score between (40.29±3.37) points in group A and (35.04±2.66) points in group B, t=8.65, P<0.001, with statistical significance.*

Comparison of ankle activity score between the two groups

The comparison of ankle activity score between the two groups indicated that the ankle activity score in group A was significantly higher than that in group B, with statistical significance (P<0.05), as shown in Figure 3.

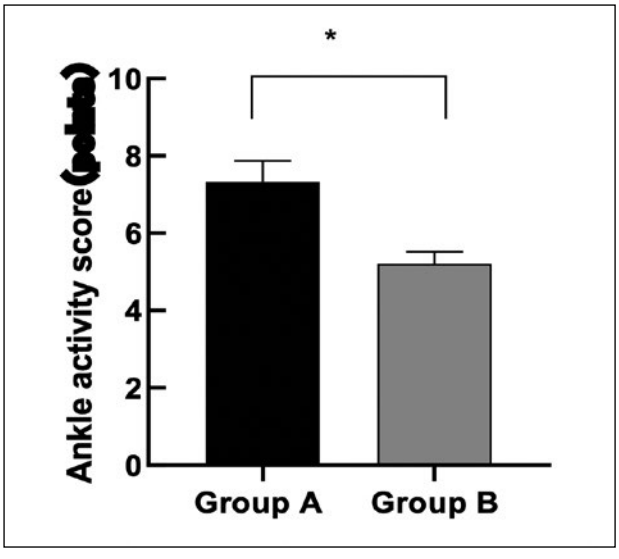

Figure 3: Comparison of ankle activity score between the two groups.

*Note: The abscissa represented group A and group B, while the ordinate represented ankle activity score. *indicated that the comparison of ankle activity score between (7.33±0.54) points in group A and (5.21±0.31) points in group B, t=24.08, P<0.001, with statistical significance.*

Comparison of the recovery of fracture sites between the two groups

Comparison of the recovery of fracture sites between the two groups through imaging test showed that osteophyte volume and callus density in group A were significantly higher than those in group B (P<0.05), as shown in Table 3.

Group	Osteophyte volume	Callus density
Group A	3.52±0.33	3.08±0.41
Group B	2.61±0.15	2.17±0.16
t	17.75	14.62
P	<0.001	<0.001

Table 3: Comparison of the recovery of fracture sites between the two groups ($\bar{x}\pm s$).

Discussion

Pilon fracture, with three types based on the severity of the fracture, type I can be treated by conservative treatment, but the same way for severer ones, types II and III fractures, may bring negative effect on the clinical outcome, leaving irreversible sequelae[15-17]; therefore, appropriate surgical methods corresponding to different types should be adopted to improve therapeutic effect and promote the recovery of the fractures.

At present, the common conservative treatment modalities include plaster immobilization after closed reduction and calcaneal traction, and the surgical treatment modalities performed mostly include one-stage open reduction and internal fixation, limited open reduction and internal fixation combined with external fixator and delayed open reduction and internal fixation[18-20]. In terms of their disadvantages, open reduction and internal fixation, though providing superior stability, nonetheless brings many soft tissue injuries, easily leading to nonunion of incision and bone ununion, and limited open reduction and internal fixation combined with external fixator has the drawbacks of poor internal fixation and easily recurrent displacement after reduction. Besides, delayed open reduction and internal fixation has longer waiting time for surgery the joint is prone to stiffness[21-22].

In order to explore the effect of Llizarov circular external fixator in the treatment of type II Pilon fracture, in this paper, patients with type II Pilon fractures were selected and received different surgeries, and then treatment effect, adverse

reactions, the recovery of the fracture sites as well as ankle function were all compared. Our results showed that patients treated with Llizarov circular external fixator in group A had significantly less operation duration and intraoperative blood loss than those treated with delayed open reduction and internal fixation in group B, with statistical significance ($P<0.05$), indicating that treatment with Llizarov circular external fixator can effectively reduce the risk of surgery and shorten operation duration. Comparison of the incidence of adverse reactions of the patients between the two groups revealed that the incidence of infection and nerve or vascular injuries after surgery in group A was significantly less than that in group B, with statistical significance ($P<0.05$), suggesting that the treatment of Llizarov circular external fixator can significantly improve clinical outcome, reduce the incidence of adverse reactions and other complications, relieve the suffering of patients and reduce the financial pressure on patients and their families.

Moreover, our study results indicated that the ankle pain score and activity score of the patients in group A were significantly less than those in group B, with statistical significance ($P<0.05$). Qi Xin, et al.[23] in their study have proposed that the treatment with Llizarov circular external fixation can significantly shorten operation duration, reduce the amount of blood loss during surgery and improve the joint function of patients. This conclusion is consistent with the findings of our study and sufficiently demonstrates the reliability of our findings.

In conclusion, treatment with the Llizarov external fixator can significantly shorten operation duration, reduce intraoperative blood loss, decrease the incidence of adverse reactions, improve ankle function and promote the recovery of fracture sites in patients with type II Pilon fracture; therefore, it has high application value in the treatment of type II Pilon fracture, which is worthy of application and promotion in clinical practise.

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