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Evaluation of the Treatment Efficacy of Bone Traction Combined with Small Splint External Fixation for Tibiofibular Fractures

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Abstract: *Objective:* To evaluate the clinical efficacy of bone traction combined with small splint external fixation in treating tibiofibular fractures. *Methods:* 378 patients with tibiofibular fractures who were treated in the Department of Orthopedics of our hospital from January 2019 to January 2023 were selected as study subjects. According to the specific conditions of the patients and the indications for surgery, they were divided into the observation group (bone traction combined with small splint external fixation) and the control group (conventional plaster fixation), with 189 cases in each group. Both groups of patients immobilized the affected limb as instructed by their doctors and were treated with oral anti-inflammatory and pain-relieving medications. The healing of the fractures was monitored using imaging techniques such as X-rays, computed tomography scans, and magnetic resonance imaging, while postoperative complications were also recorded. *Results:* The incidence rate of non-healing in the control group (7.41%) was significantly higher than that in the observation group (1.06%) ($P < 0.05$); the complications in the observation group were mainly three cases of limb deformity, three cases of pressure sores, and four cases of skin necrosis, with a total of 10 cases and an incidence rate of 5.29%; while in the control group, there were three cases of fracture nonunion, nine cases of skin necrosis, seven cases of pressure sores, and three cases of limb deformity, with a total of 22 cases and an incidence rate of 5.29%, the difference between the two groups was statistically significant ($\chi^2 = 4.916$, $P = 0.027$). *Conclusion:* Bone traction combined with small splint external fixation has shown remarkable efficacy in the treatment of tibiofibular fractures, which can not only quickly stabilize the fracture end, reduce pain, and promote fracture healing, but also reduce the occurrence of complications and shorten the treatment period.

Keywords: Tibiofibular fracture; Bone traction; Small splint external fixation; Efficacy evaluation

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1. Introduction

Tibiofibular fracture is a common disease in orthopedics, which mostly occurs in young and middle-aged males, and the injury site is mainly in the middle of the lower leg [1]. There is a wide distribution of blood vessels and nerves between the tibia and fibula, and if the fracture is severe, it will cause local hemodynamic obstruction

and even osteofascial compartment syndrome [2]. Once a vascular injury occurs, the patient may go into shock in a short time without timely treatment, it may even be life-threatening. In addition, due to the "convex" structure of the tibiofibular bone end, there is a stress concentration area around it, which can easily lead to damage to the surrounding soft tissues and joint function [3]. At present, the commonly used fixation methods for tibiofibular fractures mainly include plaster fixation and surgical fixation. Although plaster fixation is simple and easy to implement, it cannot achieve a good fixation effect, and the fracture ends are unstable and prone to dislocation of the fracture ends; whereas surgical fixation is traumatic, which aggravates the disruption of blood supply, especially in the fracture at the middle and lower part of the tibia; due to poor blood supply, surgery increases the nonunion rate of fractures. Additionally, both the initial internal fixation surgery and the subsequent removal surgery have a significant impact on the patient's health, making it unsuitable for widespread application [4]. In recent years, our hospital has continuously applied bone traction therapy to lower limb fractures, which uses traction as a means of treatment. Based on the type of fracture, different directions and degrees of traction force are applied to facilitate the realignment of the fracture ends, thus improving the fracture healing rate. This paper aims to evaluate the clinical efficacy of bone traction combined with small splint external fixation in treating tibiofibular fractures.

2. General information and methods

2.1. General information

378 cases of tibiofibular fracture patients who were treated in the Department of Orthopedics of our hospital from January 2019 to January 2023 were selected as the study subjects. Among them, 178 cases were male and 200 cases were female, with ages ranging from 24 to 71 years old, with an average of 49.41 ± 5.82 years old, and all cases met the diagnostic criteria for tibiofibular fracture. According to the specific conditions and surgical indications of the patients, they were divided into the observation group (bone traction combined with small splint external fixation) and the control group (conventional plaster fixation), with 189 cases in each group. There were 89 male and 100 female patients in the control group, aged 24–68 years old, with an average age of 49.36 ± 5.17 years old, and 89 male and 100 female patients in the observation group, aged 29–71 years old, with an average age of 49.68 ± 5.43 years old, and there was no statistical significance in the comparison of the general information of the two groups.

Inclusion criteria: patients must be diagnosed with tibiofibular fracture by medical imaging (e.g., X-ray, computed tomography, or magnetic resonance imaging); patients should have complete imaging data, including initial images before treatment and regular follow-up images after treatment, in order to accurately assess fracture healing; in order to ensure the stability and reliability of the treatment effect, patients should be followed up for at least 6 months.

Exclusion criteria: patients with open fractures or infections at the fracture site; patients with fractures at other sites are excluded as it may lead to inaccurate assessment results; patients suffering from severe osteoporosis or bone disease are excluded as it may affect their bone healing ability; pregnant and breastfeeding females are excluded considering their physiological characteristics and the possible impacts on the fetus; patients who are unable to cooperate in completing the required follow-up and treatment for various reasons and those without complete data; patients with a history of psychiatric disorders are excluded as they may not be able to accurately provide feedback on treatment and cooperate with the assessment.

2.2. Methods

Both groups of patients immobilized the affected limb as per the doctor's instructions and took oral anti-inflammatory and pain relief medications as part of the treatment. During the treatment process, the healing

of the fracture was monitored using imaging techniques such as X-ray, computed tomography, and magnetic resonance imaging, and postoperative complications were recorded.

2.3. Observation indexes

(1) Determination of efficacy: Referring to the "Bone and Joint Injury Diagnosis and Treatment Technical Specification," the treatment efficacy was determined; according to the clinical symptoms, signs, and imaging results, non-healing is defined as poor healing of the fracture end; stage I healing is defined as the fracture ends are basically aligned, there is no bone scab formation, and it reaches the normal osseous healing; stage II healing is defined as the fracture ends are formed by the formation of bone scabs, there is the formation of bone trabeculae, and the bone is completely repaired; stage III healing is defined as the disappearance of bone scabs, mild local deformation, and good functional recovery.

(2) Complications: The incidences of non-union of fracture, pressure sore, skin necrosis, limb deformity, and other complications were recorded.

2.4. Statistical methods

The research results were imported into SPSS22.0 software to analyze the data. Count data were expressed as percentages and χ^2 test was used for comparison between groups. Measurement data were expressed as mean ± standard deviation (SD), and *t*-test was used for comparison between groups, and $P < 0.05$ was taken as a statistically significant difference.

3. Results

3.1. Treatment efficacy analysis

The incidence of non-healing in the control group (7.41%) was significantly higher than that of the observation group (1.06%), and the difference was statistically significant ($P < 0.05$), as shown in **Table 1**.

Table 1. Treatment efficacy analysis

Groups	Stage I healing	Stage II healing	Stage III healing	Non-healing
Control group (n = 189)	56 (29.63)	68 (35.98)	51 (26.98)	14 (7.41)
Observation group (n = 189)	80 (42.32)	81 (42.86)	26 (13.76)	2 (1.06)
χ^2	23.140			
P	< 0.05			

3.2. Fracture complications

Complications in the observation group mainly consisted of three cases of limb deformity, three cases of pressure sores, and four cases of skin necrosis, with a total of 10 cases and an incidence rate of 5.29%. In the control group, there were three cases of fracture nonunion, including one young male patient (20 years old), which may be due to stress shielding resulting from premature weight-bearing and excessive traction post-surgery, and nonunion occurred for a longer period of time in two other patients, both of whom were elderly (50–70 years old), of which one of them had fracture nonunion due to prolonged bed rest and the other patient had recurrent episodes of chronic ankle cysts that ultimately led to fracture nonunion; nine cases of skin necrosis, seven cases of pressure ulcers, three cases of limb deformity, with a total of 22 cases and an incidence rate of 11.64%, the difference between the two groups was statistically significant ($\chi^2 = 4.916$, $P = 0.027$).

4. Discussion

In clinical practice, tibiofibular fractures are one of the common fractures in orthopedics. At present, the clinical treatment method is mainly based on plaster fixation. However, because the plaster has the disadvantages of poor fixation force and easy compression, it is difficult to achieve fracture reduction and keep the fracture end stable. At the same time, it is also prone to skin necrosis and even causes displacement of fracture broken ends, affecting fracture healing [5]. Therefore, it is necessary to optimize the existing treatment modalities in order to improve the fracture treatment effect and reduce the complication rate.

According to the literature, bone traction can effectively promote fracture healing and reduce the degree of tissue adhesion, thus facilitating functional recovery [6]. The results of this study showed that when comparing the control group with the observation group, the incidence of non-healing of the former (7.41%) was significantly higher than that of the latter (1.06%), and the difference was statistically significant ($P < 0.05$). After treatment with bone traction combined with small splint external fixation, the speed of fracture healing was significantly accelerated, and the rate of fracture non-healing was significantly reduced compared with the control group. This may be because the combination of bone traction and small splint external fixation can better correct the fracture and effectively control the fracture dislocation and soft tissue injury. In addition, the combination of bone traction and small splint external fixation can promote blood circulation at the fracture site, increase local metabolism, and promote osteoclast differentiation and proliferation, thus accelerating fracture healing. Bone traction can quickly stabilize the fracture end, effectively preventing the fracture end from further displacement or greater damage. Combined with small splint external fixation, it can further stabilize the fracture site and make the fracture end heal in the best position. Tan *et al.* [7] found that after fracture, patients often experience severe pain, the application of bone traction and small splint external fixation can reduce the stimulation of the fracture end to the surrounding tissues, thus effectively reducing the patient's pain and improving the patient's confidence in recovery and motivation. Chen *et al.* [8] found that a stable fracture environment is the basis for fracture healing. Bone traction combined with small splint external fixation provides a stable environment for fracture, which is conducive to fracture healing, and through regular imaging, it can be found that the fracture line is gradually blurred and the bone scab is formed well, which are positive signs of fracture healing. Wang *et al.* [9] found that compared with traditional plaster fixation, small splint external fixation has better breathability and adjustability, which can reduce the occurrence of skin problems and other complications in patients. Moreover, the application of bone traction was effective in preventing re-displacement and other complications associated with fractures. Shen *et al.* [10] found that through the treatment of bone traction and small splint external fixation, patients can carry out functional exercises at an early stage, which can not only promote the healing of the fracture but also reduce the occurrence of complications such as muscle atrophy and joint stiffness, which is conducive to the early recovery of patients. The stability and effectiveness of bone traction combined with small splint external fixation enable patients to reach the standard of fracture healing in a shorter period of time, thus shortening the overall treatment period.

5. Conclusion

In summary, bone traction combined with small splint external fixation has shown remarkable efficacy in the treatment of tibiofibular fractures, which can not only quickly stabilize the fracture end, reduce patient pain, and promote fracture healing, but also reduce the occurrence of complications and shorten the treatment period. Thus, this combined treatment method has a wide application prospect in the treatment of tibiofibular fractures. In the future, with the continuous development of biocompatible materials and three-dimensional printing technology, new materials and technologies that are more suitable for fracture fixation may be developed, which

may have better mechanical properties, biocompatibility, and patient comfort, thus improving the therapeutic effect of bone traction combined with small splint external fixation. With the promotion of the concepts of precision medicine and individualized treatment, more attention may be paid to individual differences in patients to tailor the most appropriate treatment plan for them. This may include choosing the most appropriate type of bone traction and small splint external fixation based on the patient's age, gender, fracture type, degree of osteoporosis, and other factors. The success of fracture treatment does not only depend on the surgical and fixation modalities but is also closely related to rehabilitation training and pathways. Future studies may further explore how to optimize rehabilitation training and pathways in order to accelerate fracture healing, reduce complications, and improve patients' quality of life.

Disclosure statement

The authors declare no conflict of interest.

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