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Case Report

Elastic nails for fibular fracture in adult tibiofibular fractures

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Abstract: Treatment of adult tibiofibular fractures, especially severely comminuted fractures, is technically challenging due to the lack of reduction markers and difficulty in restoring the alignment. Fixation of the fibula can facilitate reduction of the tibia fracture and restoration of the lower-extremity alignment. However, there are few literatures mentioned using intramedullary nail fixation for fibular fractures. Twenty-three cases of tibiofibular fractures were treated with elastic nails fixation fibular fractures and intramedullary nail or plate stabilization tibial fractures between January 2012 and December 2012. Adult tibiofibular fractures with fibular neck fractures or fibular fracture line apart from the ankle joint surface within 8 cm was ruled out. There were 19 males and 4 females with an average age of 41 years (range, 21-59 years). The injury causes included 11 falls and 12 traffic accidents. The left side was involved in 11 cases and the right side was involved in 12 cases. Seventeen cases were closed fractures and 6 cases were open fractures, all were Gustilo type I and II fractures. According to the AO classification, six fractures were defined as type 42A, 11 as type 42B, and 6 as type 42C. The average interval between injury and surgery was 5.8 d (range, 3-22 d). The operation time of elastic nails fixation fibular fractures was 24 minutes (range, 15-42 minutes). Primary wound healing was achieved in all patients. No complications such as infection and wound necrosis occurred. Twenty-one patients were followed up for a mean follow-up period of 16.3 months (range, 12-26 months). The mean duration of fracture healing in the radiographs was 4.1 months (range, 3-8 months). No recurrent fracture dislocation and breakage of implant were observed. At the last follow-up visit, the lower-extremity alignment was excellent. Two degrees of varus deformity was found in 3 cases, and 2 degrees of valgus deformity was observed in 2 cases, but there were no serious varus or valgus deformity affecting the lower-extremity function or causing pain. The results of Tornetta's ankle function scoring were excellent in 17 cases, good in 3 cases, and fair in 1 case; and the good-to-excellent rate was 95.2%. In the case of adult tibiofibular fractures, elastic nails fixed fibular fracture is helpful to maintain and adjust the lower limbs axis, help tibial fracture reduction, and increase stability.

Keywords: Tibiofibular fracture, elastic nail, intramedullary nail, internal fixation

Introduction

Most adult fracture of tibia and fibula are caused by high-energy trauma and characterized by comminuted fracture type. In particular, there is no definite marker for the reduction of multi-segmental tibiofibular fractures, which makes the restoration of alignment extremely difficult. Anatomical reduction and fixation of the fibula fracture can be performed in advance to facilitate reduction of the tibia fracture and restoration of the lower-extremity alignment. Fixation of the fibula fracture is often carried out using K-wires, reconstruction plates or dynamic compression plates [1]. However, plate fixation of the fibula fractures may cause severe trauma and obtaining anatomical reduction for the comminuted fractures is difficult and further affects the reduction and fixation of the tibia fracture. Elastic nails are commonly used in the treatment of long bone fractures in children [2-5], but rarely applied to the adult fractures. In 23 adult patients with tibiofibular fractures, we applied closed reduction and elastic nail fixation for the fibula fracture and performed intramedullary nailing or plate fixation for the tibia fracture between January 2012 and December 2012, and achieved satisfactory outcomes.

Materials and methods

General information

All enrolled patients had adult tibiofibular fractures. Patients with a fibula fracture line within

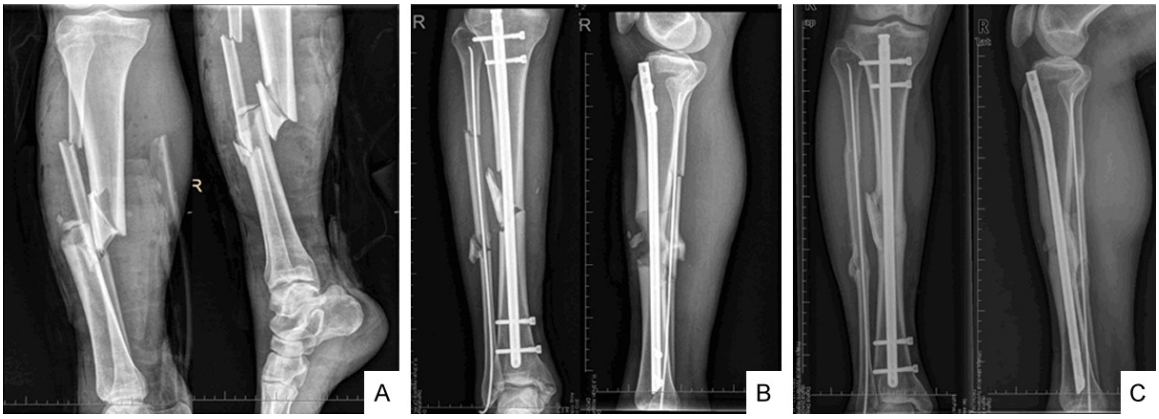

Figure 1. A 44-year-old male patient with tibiofibular fracture of type 42B. A. Anteroposterior and lateral X-ray films before operation; B. Anteroposterior and lateral X-ray films at one week after operation; C. Anteroposterior and lateral X-ray films at one year after operation, showing fracture healing without loosening or breakage of internal fixation.

Figure 2. A 55-year-old female patient with tibiofibular fracture of type B. A. Anteroposterior and lateral X-ray films before operation; B. Anteroposterior and lateral X-ray films at one week after operation; C. Anteroposterior and lateral X-ray films at one year after operation, showing fracture healing without loosening or breakage of internal fixation.

8 cm from the ankle joint or with fibular neck fractures were excluded. There were 23 patients, 19 males and 4 females. The mean age was 41 years (range, 21-59 years). The injury causes included 11 falls and 12 traffic accidents. The left side was involved in 11 cases and the right side was involved in 12 cases. Seventeen cases were closed fractures and 6 cases were open fractures, all were Gustilo type I and II fractures. According to the AO classification, six fractures were defined as type 42A, 11 as type 42B, and 6 as type 42C. The average interval between injury and surgery was 5.8 d (range, 3-22 d).

Therapeutic method

After spinal or general anesthesia, lower-extremity alignment was maintained by manual traction, and a small incision was made in the tip of the lateral malleolus. An awl was used to make an opening canal in the distal end of the fibula, and a 2.5 or 3.0 mm elastic nail was inserted. Reduction of the fibula fracture was carried out under C-arm fluoroscopy, and the proximal end of the fractured fibula was searched using the cephalic end of the elastic nail. The elastic nail was inserted proximal to the facture site under the guidance of fluoroscopy by adjusting the nail direction and modulating the reduction position. If the closed reduction and nail insertion were difficult, a small assistant incision was made for easier reduction and nail insertion. After fixation, the caudal end of the elastic nail was bent, shorted, and buried under skin. Next, intramedullary nailing or plate fixation was carried out for the tibial fracture.

Postoperative management

Patients started ankle and knee flexion and extension exercises immediately after surgery, and begun ambulation with crutches and non-weight bearing functional exercise of the affected limb 2 to 3 days after soft tissue swelling disappeared. For patients with type A fractures, partial weight bearing (15 kg) was started 1 week after surgery. A weight of 3 kg was added every week until full weight bearing. For patients with type B and C fractures, partial weight bearing (15 kg) was started 2-4 weeks after surgery; a weight of 3 kg was added every week and full weight bearing was allowed according to the status of fracture healing.

Observation and measurement

Follow-up occurred 4 weeks after surgery, every three months X-ray examination was performed during the follow-up visits to observe the status of fracture healing. The status of fracture healing, lower-extremity alignment, and Tornetta's ankle function scores were evaluated at the end of the follow-up [6].

Results

The mean operation time of elastic nail fixation was 24 min (range, 15-42 min). Closed reduction and nail fixation were performed successfully in 18 cases and a limited small incision was made in 5 cases. Primary wound healing was achieved in all patients. No complications such as infection and wound necrosis occurred. Twenty-one patients were followed up for a mean follow-up period of 16.3 months (range, 12-26 months). The mean duration of fracture healing in the radiographs was 4.1 months (range, 3-8 months). No recurrent fracture dislocation and breakage of implant were observed. At the last follow-up visit, the lower-extremity alignment was excellent. Two degrees of varus deformity was found in 3 cases, and 2 degrees of valgus deformity was observed in 2 cases, but there were no serious varus or valgus deformity affecting the lower-extremity function or causing pain. The results of Tornetta's ankle function scoring were excellent in 17 cases, good in 3 cases, and fair in 1 case; and the good-to-excellent rate was 95.2% (**Figures 1**, **2**).

Discussion

The incidence of combined tibia and fibula fracture in adults is relatively high in clinical practice. High-energy trauma is the most common cause of this kind of fracture. It is usually an open fracture with serious soft tissue injury. If it is a comminuted fracture or a multi-segmental fracture, treatment is technically challenging due to the lack of reduction markers and difficulty in restoring the alignment. Intramedullary nailing or minimally invasive bridge plating is often performed to fix the tibia after closed reduction for patients with this kind of fracture, and no fixation is required for the fibula fractures located more than 8 cm superior to the ankle joint. However, in patients with severely comminuted fractures, anatomical reduction and fixation of the fibula can facilitate reduction of the tibia fracture and restoration of the lower-extremity alignment.

Fixation of the fibula is still controversial. Ankle stability may be affected by the destroyed continuity of the fibula [7]. Even the proximal fibula fracture can reduce the ankle stability in cases with fracture displacements, which may result in widening of the ankle mortise and superior displacement of the lateral malleolus. Uzun found that fibular fractures in the middle or proximal one-third may need to be stabilized at the time of tibial intramedullary nail fixation to prevent development of hind foot valgus due to fibular shortening [8]. Attal observed additional fibular plating does not improve stability if a multidirectional distal locking intramedullary nail is used, and is therefore unnecessary if not needed to aid reduction [9]. Berlusconi reported that higher non-union rate when the fracture of the tibia and fibula were at the same level, the tibia was fixed with a bridging plate and the fibula left untouched [10]. Therefore, the author suggested fibular fixation in all distal fractures when both fractures lie on the same plane and the tibial fracture is relatively stabilized. Bonneviall found that fibula fixation could help the reduction of the tibial fracture, maintain the tibial alignment. Risks of reduction defects, tibiofibular instability and tibial nonunion increased when the fibula was not fixed [11]. Egol and Prasad found that the plate fixation of the fibula fracture could help the reduction of tibial fracture and maintain it, and they suggested routine plate fixation of the fibula for cases with unstable tibia and fibula fractures [12, 13]. Therefore, we believe that the additional fibula fixation is helpful for patients with complicated tibia and fibula fractures, tibia and fibula fracture lines on the same plane, and

patients who underwent plate fixation for the tibia fracture.

Our finding suggest that for adult tibia and fibula fractures, reconstruction plates or dynamic compression plates can be used to fix the fibula. However, plate fixation of the fibula may cause serious trauma, cannot achieve anatomical reduction for comminuted fractures, and even affects the reduction and fixation of the tibia. The main complication of the fibular plating is wound infection, with an incidence up to 26% [14]. Moreover, intramedullary nailing of the tibia is relatively stable fixation while the fibular plating is absolutely stable fixation, which may induce imbalance in the mechanical properties and affect the healing of the tibia fracture. Therefore, it seems that interlocking intramedullary nail fixation of the fibula is an ideal choice. It was reported that intramedullary nailing even could be used for non-comminuted fractures of the lateral malleolus, with better outcomes and fewer complications compared with plate fixation. Intramedullary nail fixation of the fibula is minimally invasive with an incision about 1 cm in length with fewer wound infections, and a high rate of fracture healing [16, 17]. It also helps to restore function and results in patient satisfaction [18]. Although the intramedullary nail fixation of the fibula is a complicated procedure, application of the elastic nail can make this procedure simple and easy, effectively restore the length of the fibula, correct the valus and valgus deformities, maintain the alignment, facilitate the reduction of the tibia, and simplify the internal fixation of the tibia. However, the anti-rotation ability of the elastic nail is relatively poor and rotational deformities should be prevented during surgery. In the present study, the lower-extremity alignment and the location of the tibia fracture improved significantly after applying the elastic nail for fixation of the fibula, which facilitated the following internal fixation of the tibia, even if additional reduction of the tibia was required, and the lower-extremity alignment had to be adjusted. However, adjustment of the alignment is extremely difficult after applying the plate fixation to the fibula, and the plate has to be removed in some cases. We believe that application of the elastic nail in the fixation of the fibula can simplify the surgical procedure, increase the stability, and maintain the lower-extremity alignment in the treatment of complicated tibia and fibula fractures.

The elastic nail can be placed in using the minimally invasive technique to avoid making large incisions and destroying the blood supply. Patients can recover quickly after surgery and limb function can be restored satisfactorily. In addition, the nail can be easily removed after fracture healing. Characteristics of the elastic nailing and tips for the surgical procedure are detailed below.

The nail should be placed in using the minimally invasive technique after closed reduction to preserve the blood supply and promote fracture healing. If the minimally invasive procedure is failed, then a small assistant incision should be made to help reduction and fixation.

The proximal end of the fractured fibula can be detected by the cephalic end of the elastic nail.

The length of inserted nail should be long enough to reach the neck of the fibula for increasing stability.

The diameter of the elastic nail should be a value less than 1 to 1.5 mm from the diameter of the medullary cavity of the fibula, commonly used elastic nails are 2.5 to 3 mm in diameter [19]. If the nail is too thin, the strength of fixation may be not enough; if the nail is too thick, it is difficult to insert.

The opening canal for the elastic nail insertion should be located at the anterolateral quadrant of the tip of the lateral malleolus to avoid injury of the sural nerve or peroneal tendon [20].

After the fibula is fixed with an elastic nail, internal fixation of the tibia fracture can be performed. The lower-extremity alignment should be observed carefully and rotational deformity should be prevented.

In addition, the elastic nail can be broken and residued in the medullary cavity of the fibula after internal fixation in cases of secondary trauma. The patient should be warned before surgery concerning this risk because removal of the elastic nail is extremely difficult in this condition. Therefore, for adult patients with combined tibia and fibula fractures, especially complicated fractures, the fibula can be fixed with an elastic nail prior to the fixation of the tibia. Because it is a minimally invasive technique and has excellent biomechanical advantages, this technique can achieve satisfactory

outcomes, which is presented as increased stability, correction and maintenance of the lower-extremity alignment, etc.

Disclosure of conflict of interest

None.

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