

The Ilizarov Mini-External Fixator for the Treatment of First Metatarsal Fracture: A Case Report

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Forefoot fractures are frequently accompanied by severe soft tissue damage. Therefore, treatment should focus not only on fractures but also on soft tissue damage, for which external fixation can be used as a surgical option. A 63-year-old woman presented to the emergency clinic of our hospital with forefoot pain after a motorcycle accident. Comminuted fracture of the proximal part of the metatarsal was diagnosed. Because of the swollen foot and fracture comminution, an operation using the Ilizarov mini external fixator was performed to prevent further damage to the soft tissue. Weight-bearing was permitted seven weeks after the operation, and the extraction of the apparatus was performed nine weeks postoperatively. One year later, the patient had no pain and had returned to ballroom dancing, a hobby which she performed five days a week, with no difficulties. Our results suggest that the Ilizarov mini external fixator should be considered not only for temporary treatment, but also for the entire duration of treatment of first metatarsal fractures associated with severe soft tissue damage.

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Key words: trauma, metatarsal, minimally invasive, external fixation, Ilizarov

Introduction

The first metatarsal is considerably wider and stronger than the other four metatarsals and one-third of the body weight is transferred through it. A fracture of this bone is rare in adults. A previous report stated that metatarsal fractures account for 5% of all fractures, and that only 1.5% of metatarsal fractures occur in the first metatarsal¹. For treatment, any evidence of instability or loss of the normal position of the metatarsal head should be managed with operative stabilization. For simple fractures of the shaft or articular surface, percutaneous smooth wires or screws are used. In contrast, for transverse or minimally comminuted fractures, plate and screw fixation should be employed². However, once a fracture occurs, because of the paucity of subcutaneous tissue, the forefoot swells, making it difficult to use plate and screw fixation because of its bulky size. Here, we report a case for which we used an Ilizarov mini external fixator to treat a comminuted first metatarsal fracture. We have found no reports describing such a treatment in the English literature.

Case Report

A 63-year-old woman, without a remarkable medical history, presented to the emergency department of our hospital with left foot pain after a motorcycle accident. She was unable to walk without support when entering the consultation room because of the pain. There was tenderness at the base of the left first metatarsal bone, and the foot was markedly swollen. Radiography revealed a first metatarsal fracture (**Fig. 1**), and for temporary treatment, a short leg-immobilizing splint was applied. She was asked to visit the orthopedic outpatient clinic the next day. After visiting the orthopedic department the next day, she underwent a computed tomography scan of the foot to evaluate the fracture in further detail, where it was revealed that the base of the first metatarsal had an AO type C3 comminuted fracture (**Fig. 2**).

Sixteen days after the injury, an operation was performed with the patient in the supine position, under general anesthesia, with a tourniquet applied. The operation had been delayed because the patient was initially unwilling to undergo surgery. After an incision was

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made the ossicles were reduced to the articular surface of the medial cuneiform and fixated with a 1.5 mm wide Kirschner wire. Thereafter, because of the marked swelling and shortening, we chose an Ilizarov mini external fixator instead of a plate and screws to prevent soft tissue damage and to protract the distal metatarsal for reduction. We inserted three 1.5 mm Kirschner wires into the distal part of the first metatarsal, two into the navicular bone, and one into the medial cuneiform and connected the distal three and proximal three wires to the distal and proximal unit of the external fixator. Subsequently, we protracted the distal unit distally and laterally, and after the reduction, connected the two units with rods (Fig. 3). No weight-bearing was permitted for 7 weeks after the surgery, until the tenderness had completely disappeared, and only 50% partial weight-bearing

was permitted at 8 weeks. The fixator was removed at 9 weeks (Fig. 4), and full weight-bearing was permitted at 10 weeks after the operation. Bone union was observed after two months, and the patient returned to her hobby of ballroom dancing five days a week after six months. At 12 months after the surgery, she had no pain or difficulty walking, and she received the highest score on the Japanese Orthopaedics Association (JOA) score and the Japanese Society for Surgery of the Foot (JSSF) hallux score. After the one-year follow-up, the patient gave informed consent.

Discussion

Because of the limited soft tissue coverage, and a minimal layer of subcutaneous struts and resistant skin, when an acute injury occurs in the forefoot, soft tissue damage is often severe. In addition, because of the high energy of the injury, deformity and comminution frequently accompany injury. In such cases, immediate open reduction and internal fixation are difficult. Accordingly, we considered external fixation for this patient.

External fixation is usually used temporarily to re-establish the anatomic axes and dimensions of the foot and to reduce soft tissue strain³⁻⁹. However, its ability to distract, compress, stabilize, and neutralize⁴ allows for the expansion of the indication of external fixation to joint arthrodesis, osteotomy fixation, brachymetatarsal correction, elongation of the shortened metatarsal, and reduction in the soft tissue contracture. Thus, these apparatuses can also be used to completely heal such patients.

One advantage of external fixation over internal fixation is that an external fixator can be used in open and/or infected fractures. Managing soft tissue damage is difficult in open fractures and, with bulky metal underlying



Fig. 1 Radiograph of the left forefoot. There is a comminuted fracture of the first metatarsal.

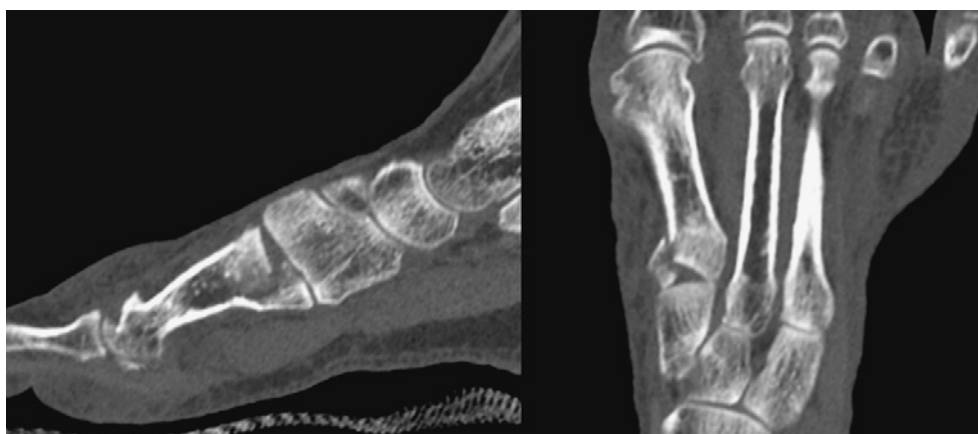


Fig. 2 A computed tomography scan of the left forefoot. The first metatarsal has a comminuted fracture on the articular surface.

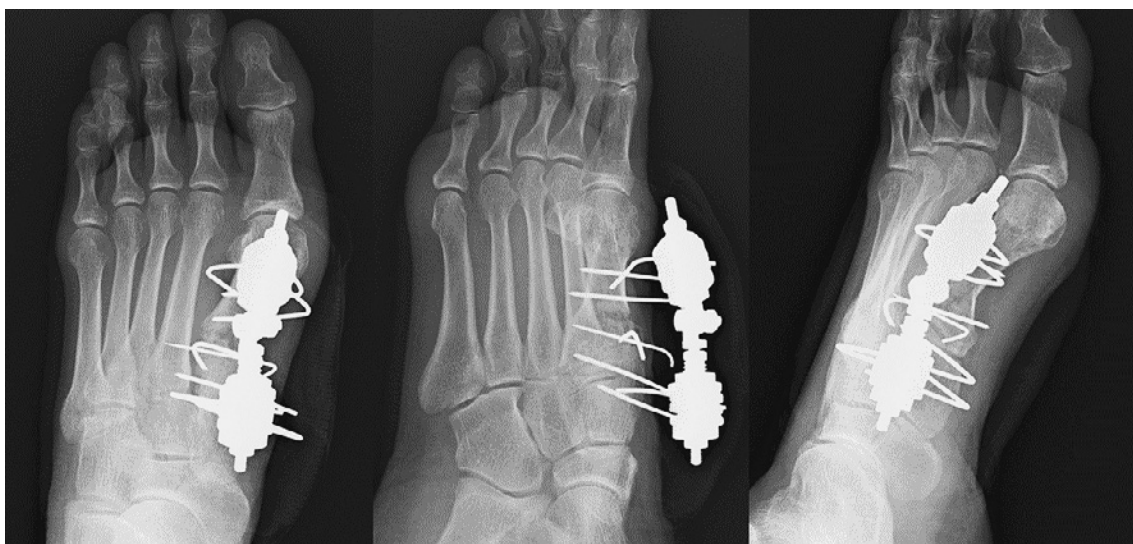


Fig. 3 Radiography of the left forefoot immediately after the operation.



Fig. 4 Radiography of the left forefoot after the extraction of the external fixator.

the wound, management is even more difficult. In some cases, consultation with a plastic surgeon for reconstruction is needed. Therefore, stabilizing the fracture with external fixation by inserting the pins and wires away from the wound is useful. The same advantage holds true when the wound is infected. Another advantage of external fixation is that once the pins or wires are inserted and the unit is installed, reduction can be easily accomplished by distraction or compression. In addition, when reduction is insufficient, additional attempts are possible without any damage to the bone or the soft tissue, unlike with internal fixation, which would require invasive pro-

cedures.

However, one major disadvantage of external fixation is the risk of infection, as infection occurs at a relatively high rate with external fixation. The pins or wires act as a portal for bacteria, thus keeping the apparatus clean is key to preventing infection. Should an infection develop, oral or intravenous antibiotics are preferred for treatment, but if the infection cannot be managed, removal of the apparatus and debridement are required. Furthermore, if bone union has not been achieved, additional treatment of osteomyelitis is needed, substantially worsening the outcome. Another potential disadvantage is

damage to blood vessels when inserting the pins or wires. When inserting the pins or wires into the first metatarsal the deep plantar artery may be penetrated. The deep plantar artery is a branch of the anterior tibial artery and it passes plantarward between the first and second metatarsals. Barret et al. reported that when inserting a single 4.0 mm Schanz pin from the medial to lateral aspect across the bases of the first and second metatarsals in 10 cadaveric feet, the deep plantar artery was lacerated in 5 feet and the pin contacted the artery in 4 feet¹⁰. The difficulty of managing the apparatus is another disadvantage. Seeing the apparatus may induce fear or apprehension in patients and it may affect their daily activities, such as putting on shoes.

For fractures, an external fixator is used mainly for temporary reduction. However, in a severely comminuted or open first metatarsal fracture, it can also be used for the entire duration of treatment¹¹. In the present case, external fixation was selected to be used for the entire duration of treatment due to the extensive soft tissue damage and deformity. By using external fixation, the soft tissue damage was minimized, and the reduction was easily accomplished.

In the present case, we selected the Ilizarov mini external fixator from the available apparatuses. The use of this external fixator has been reported for fractures of the fifth metatarsal in top athletes, and the percentage of radiographic consolidation and clinical healing was comparable to that in screw fixation techniques¹². However, we were unable to locate any previous English-language studies using such a fixator for a closed, minimally comminuted first metatarsal fracture. One advantage of this fixator is the decreased risk of damaging the deep plantar artery. Barret et al. reported that, as the angle of entry became more perpendicular to the sole of the foot, the risk to the artery decreased¹⁰. The flexibility of the Ilizarov mini external fixator, allowed the wire to be inserted at several different angles, which decreased the likelihood of artery damage. In addition, its relatively small size makes management easier. However, because

of the lack of other reports as reference, the optimal timing for weight-bearing and apparatus removal is still unclear, making further studies to evaluate these necessary.

In summary, the use of the Ilizarov mini external fixator should be considered not only as a temporary measure, but also for the duration of treatment for acute first metatarsal fractures.

Conflict of Interest: None.

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