Simultaneous Joint Arthrodesis and Bone Lengthening by the Ilizarov Method (A Case Report)

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✔ Large osteoarticular defects of the extremities are challenge cases in orthopaedic surgery. Although there are several conventional treatment options for this kind of skeletal defects, the rate of success is low. We report the case of a 48-year-old patient in whom a large osteoarticular defect including the whole distal tibia, distal fibula and talar dome of the right leg, due to a gunshot injury, was treated with tibial lengthening and tibiotalar fusion by the Ilizarov method. Selected treatment was not just a simultaneous arthrodesis and limb lengthening procedure. Whole distal tibia and ankle region was simultaneously reconstructed using tibiotalar fusion and proximal tibial lengthening. The Ilizarov method is the most important alternative for the orthopaedic surgeon in the reconstruction of large osteoarticular defects of the skeleton.
Key words: *Osteoarticular defect, bone transport, tibiotalar fusion, the Ilizarov method, ankle*

✔ **İlizarov Metodu ile Eş Zamanlı Artroez ve Kemik Uzatılması**
Ekstremitelerin büyük osteoartiküler defektleri ortopedik cerrahinin oldukça güç olgularındandır. İskelet sisteminin bu tür defektleri için çeşitli geleneksel tedavi yöntemleri olsa da, başarı oranı düşüktür. Ateşli silah yaralanmasına bağlı tüm distal tibia, distal fibula ve talus kubbesini içeren büyük bir osteoartiküler defekte sahip olan 48 yaşındaki hastanın İlizarov yöntemiyle tibial uzatma ve tibiotalar füzyon ile tedavisini rapor ediyoruz. Seçilen tedavi yöntemi sadece eş zamanlı yapılmış bir artrodez ve ekstremite uzatma işlemi değildi. Bütün sağ distal tibia ve ayak bileği bölgesi tibiotalar füzyon ve proksimal tibial uzatma yapılarak rekonstrükte edildi. İlizarov yöntemi iskelet sisteminin büyük osteoartiküler defektlerinin rekonstrüksiyonunda ortopedik cerrah için en önemli alternatiftir.
Anahtar kelimeler: *Osteoartiküler defekt, kemik transportu, tibiotalar füzyon, ayak bileği*

CASE REPORT

A 48-year-old woman who had sustained a gunshot injury was initially treated with soft tissue covering procedures and fixation with an Orthofix external fixator and a Rush pin at another hospital for comminuted, defective, grade IIIC open fracture of the right tibia. After three months, she was referred to our department with a flail foot, a painful nonunion of the right ankle and leg-length

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discrepancy of 7.5 cm. She had a drop-foot deformity because of peroneal nerve damage. Radiographs showed that the right distal tibial metaphysis, tibial plafond, distal fibula and talar dome were wholly absent (Fig. 1). For this reason, we decided on tibiotalar fusion and lengthening of the right tibia, using an Ilizarov circular external fixator to compensate for the 7.5 cm leg-length discrepancy. The frame was preassembled before surgery according to a bifocal Ilizarov method for a stable tibiotalar fusion with simultaneous limb lengthening via proximal tibial osteotomy. Two proximal and two distal rings were used for the tibia and two half-rings for the calcaneus and the metatarsals. The whole frame was connected with threaded rods. First, the Orthofix external fixator and Rush pin were removed and the pin-track sites were cleaned. A transverse wire was passed approximately 2.0-3.0 cm below the knee joint in the proximal tibia, perpendicular to the anatomical axis of the tibia. Another transverse wire was then passed approximately 3.0-4.0 cm above the distal end of the tibia in the same manner. These were connected to the most proximal and distal rings and acted as reference wires for the frame. The frame was further stabilized with wires and half-rings. The osteotomy was performed at the proximal metaphysis between the second and third tibial rings. A supplemental osteotomy was performed on the fibula at the mid-diaphyseal level. The fourth ring, which was applied the furthest below the tibia, and the half-ring of the calcaneus were compressed and the patient was mobilized with crutches without weight-bearing immediately after surgery. After seven days, the patient started proximal tibial lengthening (1.0 mm/day divided into four equal intervals) and distraction-compression of the fusion site (Fig. 2, 3). Distraction, waiting and compression were applied for periods of five days at the fusion site, in sequence. This process was repeated three times. During this procedure, translation deformity between diaphysis of the distal tibia and talus occurred on the sagittal plane. It was corrected acutely with translation construct using original Ilizarov parts. A 6.5 cm limb lengthening was achieved with complete consolidation of the regenerate bone at the end of seven months and complete union at the fusion site. We especially aimed the remaining 1.0 cm leg-length discrepancy because of tibiotalar fusion. Clinical and radiological examinations at this time suggested stable bone fusion at the lengthening and nonunion sites, and the frame was removed (Fig. 4a, b). The patient used an below-knee orthosis for two months to protect the lengthening and fusion sites. At the latest follow-up, 24 months after frame removal, the patient had returned to a normal life without pain and did not require a walking aid.

Fig. 1. Anteroposterior radiograph showing large osteoarticular bone defect including whole distal tibia and talar dome. The bony surfaces had been fixed by an Orthofix external fixator and a rush pin.

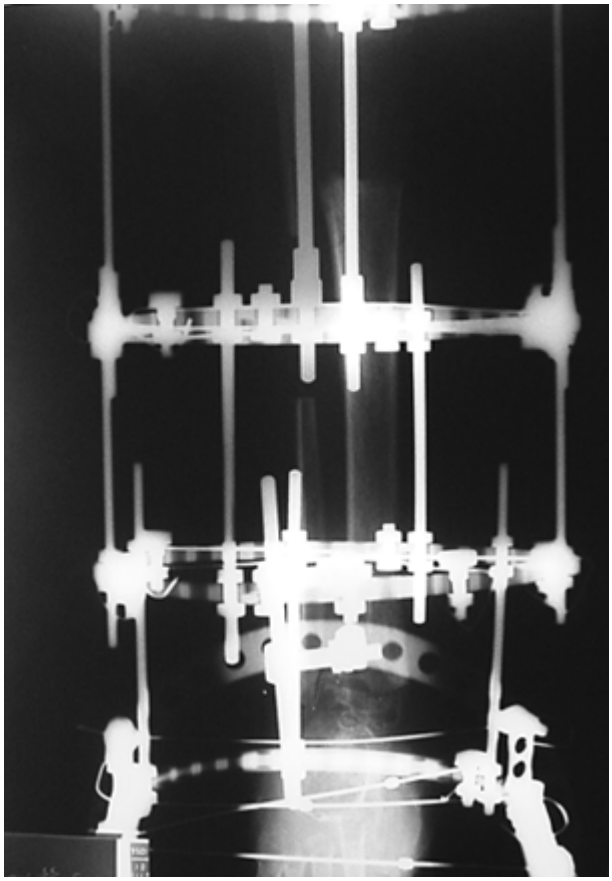

Fig. 2. Anteroposterior radiograph showing Ilizarov stabilization and distraction of the osteotomy site at the end of lengthening. It is noted 6.5 cm of lengthening at the proximal metaphysis of the tibia and early finding of union in tibiotalar area.

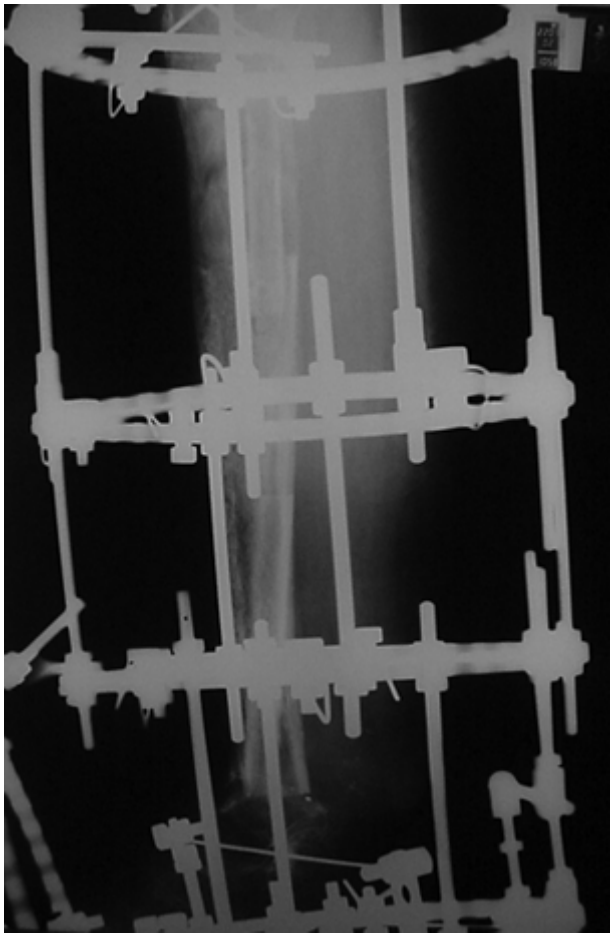

Fig. 3. Lateral radiograph showing regenerate consolidation phase of the lengthening site at the proximal metaphysis of the tibia and tibiotalar fusion at the postoperative four months.

DISCUSSION

Gunshot injuries are frequent causes of segmental and osteoarticular defects of the skeleton. The management of this kind of fracture is challenging and controversial, particularly when there is a bone defect of more than 3.0 cm. There are several treatment options for segmental and osteoarticular bone defects, such as conventional bone grafting, free vascularized bone grafting, bone transport, acute or gradually shortening, bone transport procedures and amputation[1-4]. Gavril Abramovitch Ilizarov invented the tensioned wire circular external fixator in Kurgan, Siberia, in 1948, and his method was successfully used for segmental bone defects. In our patient, the bone defect included the whole ankle region and distal metaphysis of the tibia and was a typical osteoarticular bone defect. Thus, we planned tibiotalar fusion and proximal tibial lengthening for a functional lower limb. For this simultaneous procedure, the use of the Ilizarov method was unique.

Complications occur at high rates with conventional treatment methods for large segmental bone defects[2,3]. However, during the periods of external fixation our patient complained of superficial pin-track infections. She did not sustain any other complication.

Cierny and Zorn[2] evaluated two different methods of managing segmental bone defects of the tibia; 23 patients treated with the conventional method with massive cancellous grafts and tissue transfers were compared with 21 patients treated with the Ilizarov

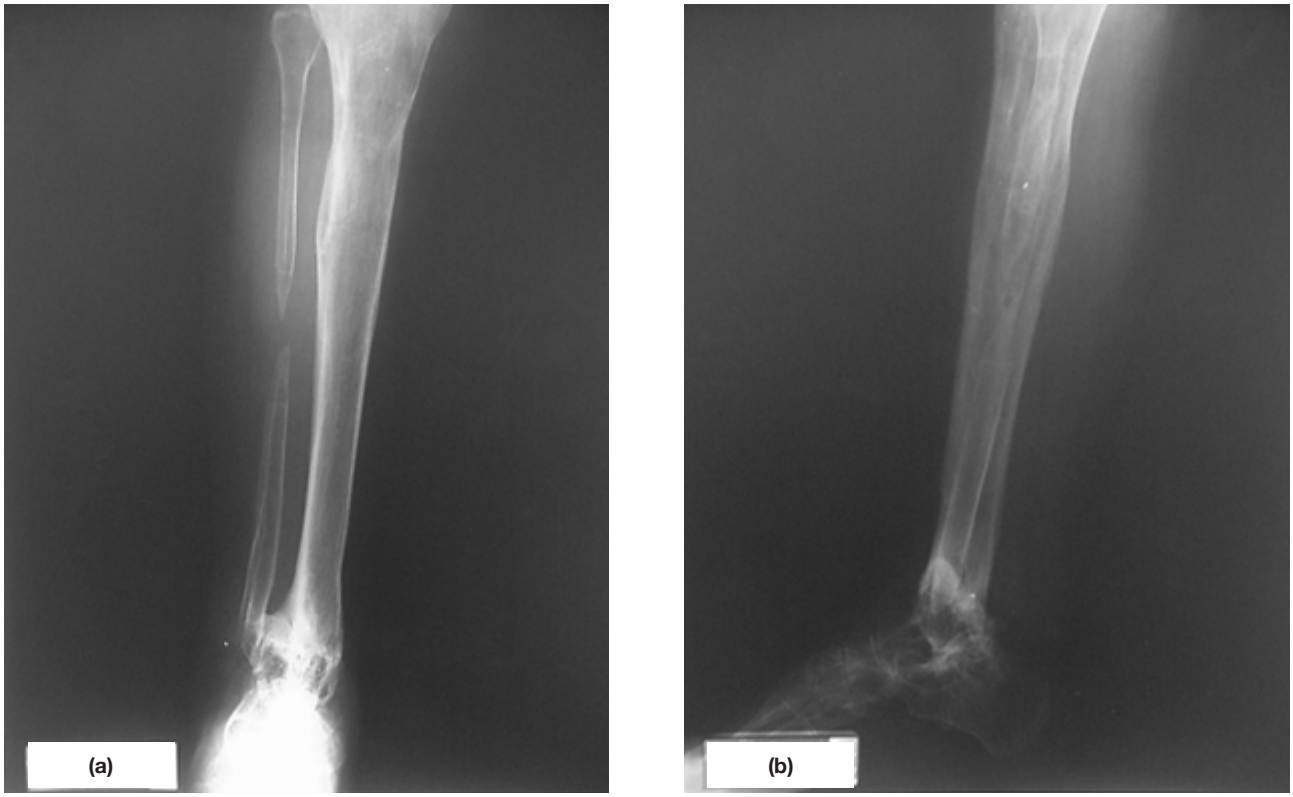

Fig. 4. a) Anteroposterior and **b)** lateral radiographs showing the final results after limb lengthening proximally and fusion distally. The completed reconstruction with excellent alignment, length, regenerate consolidation, fusion site union.

method. Major complication rates were 60% for conventional methods and 33% for the Ilizarov method. They emphasized that the Ilizarov method proved faster, safer, less expensive and easier to perform.

Marsh et al[4] also compared conventional methods versus bone transport in 25 patients with infected nonunions and segmental bone loss of the tibia. They stated that the final limb-length discrepancy was significantly less in the bone transport group.

In the literature, there are several articles about knee arthrodesis and limb lengthening with the Ilizarov method in the treatment of infected total knee arthroplasty[5,6]. In addition, Uehara et al[7] reported a case of ankle arthrodesis and tibial lengthening for congenital sensory neuropathy with anhidrosis. None of them have a traumatic etiology. In the present study the method was not a simple bone transport procedure. It was also not a simultaneous arthrodesis and limb lengthening procedure. Whole distal tibia and ankle region was simultaneously reconstructed using tibiotalar fusion and proximal tibial lengthening. We emphasize that the Ilizarov method permits both distraction-compression at the nonunion site and simultaneous correction of leg-length discrepancy by distraction osteogenesis and allows adjustment of the translation between the talus and the distal end of the tibia.

In conclusion, bone transport for osteoarticular skeletal defects appears to be an effective approach, and has many advantages in the reconstruction of an injured limb. The Ilizarov method seems to be the most important tool for the orthopaedic surgeon in the treatment of osteoarticular defects of the skeleton.

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