Tibial bone loss and soft-tissue defect treated simultaneously with Ilizarov-technique—a case report

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A 36-year-old active fisherman had the lower anterior part of his leg blown off by a signal flare. The soft-tissue defect measured 10 × 15 cm with a large defect in the peroneal muscles. All extensor tendons to the foot were blown off. The tibial bone loss was 9 cm and the fibula defect 3 cm (Figure 1). The anterior tibial artery and vein as well as the superficial branch of the peroneal nerve were destroyed and there was dysesthesia along the dorsal part of the foot and on the first toe. The posterior tibial artery and nerve were intact, including the sural nerve.

The patient was immediately admitted to the nearest hospital, where the devitalized tissue was removed. An external fixation was applied by Hoffman's method (Figures 1 and 2) and antibiotic treatment was initiated.

17 days after the injury, the patient was sent to us. The open fracture, infected with staphylococcus aureus, was classified as Gustilo IIIB (Gustilo et al. 1984). The devitalized bone was curetted to firm, bleeding bone, and surrounding scar tissue was excised. The Hoffman apparatus was removed, and external fixation was applied using Ilizarov's technique (Figure 3), this day is referred to as day 0 (Figure 6). The apparatus was applied with the hinges placed on the frame medially and laterally on each side of the leg in the frontal plane, on a level with the center of the defect. The bone defect was reduced by 3 cm in one step, to reduce the soft-tissue lesion (Figure 3). On day 6, an anterior angulation (Figure 4) was carried out, with a bending point at the center of the bony defect, at a rate of 4 degrees per day (1 degree × 4 per day). Compression was performed along with angulation in the segment defect, at a rate of 1/2 mm × 4 a day. After angulating for 16 days (day 22), the proximal and distal ends of the soft-tissue defect were brought into contact. The final angulation was about 64 degrees. Due to the angula-

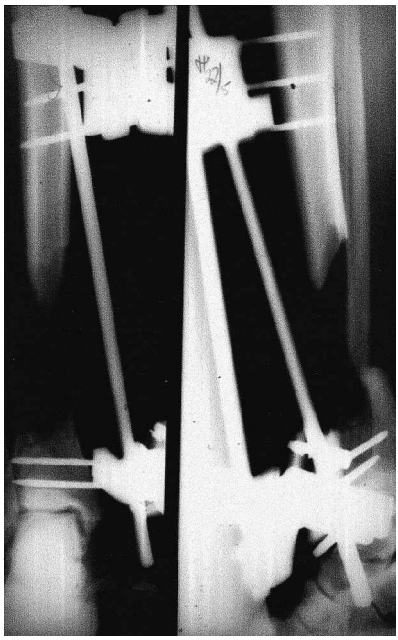

Figure 1. Frontal and lateral projections of the bone defect with an emergency fixation using Hofman's method.

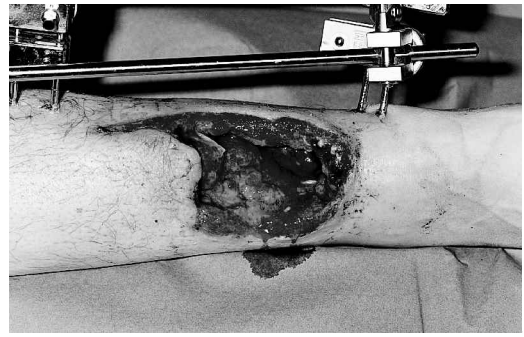

Figure 2.The lower leg with infected soft-tissue defect and the Hoffman apparatus in place.

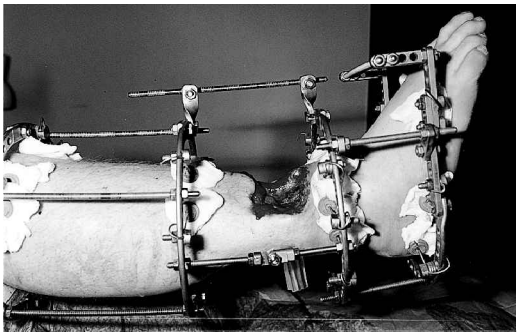

Figure 3. The Ilizarov apparatus has been applied to the leg on day 0, with 3 cm defect reduction.

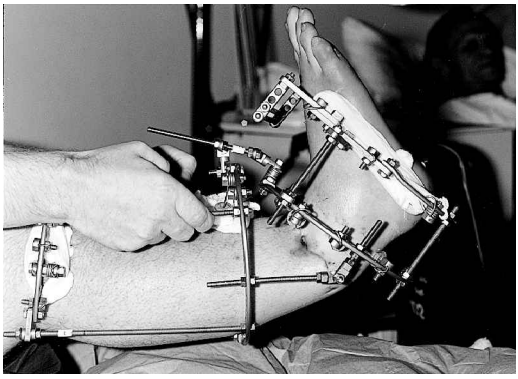

Figure 4. Angulation in the bone- and soft-tissue defect.

tion, the distal tendons of the extensor digitorum longus and extensor hallucis longus could be sutured to the proximal musculotendinous junction, and it was also possible to suture the tendon defect in the anterior tibial muscle, tendon to tendon.

A proximal tibial osteotomy was done on day 27, with 7 days of neutral fixation. The segment transport was started on day 34, at a rate of 1/4 mm × 4 a day, in the distal direction. The straightening of the angulation was initiated on day 47, with a distraction of 1/4 mm × 6 anteriorly and 1/4 mm × 2 posteriorly, 20 days after tendon suturing and soft-tissue coverage. After 51 days of distraction of the osteotomy (day 85), the bone ends in the defect began to meet, and compression of these was commenced at a rate of 1/4 mm × 4 a day, for 7 days. After 90 days of distraction, the tibia had reached its original length (day 125). The Ilizarov apparatus was removed after 1 year. The healing index was 40 days per cm. Last follow-up examination was carried out 2 years after removal of the apparatus (Figure 5). The patient is now back at his old trade, working as a fisherman on the North Sea. He has no pain, no foot drop and uses ordinary footwear. The patient's active range of motion in the knee is 0 degrees extension and 135 degrees flexion. In the ankle, the patient's active range of motion is 5 degrees extension and 15 degrees flexion. The leg lengths are equal.

Figure 5. 2 years after removal of the Ilizarov apparatus.

Time scale

Day	Event
0	External fixation with Ilizarov-apparatus
7	Angulation at a rate of 4° per day
21	Angulation stopped at 64°
27	Proximal osteotomy and tendon suturing
34	Segment transport
47	Straightening of the angulation with 4° per day
62	The angulation is straightened, and the frame on the foot is removed
85	Docking of transport segment with distal segment
125	Distraction is stopped (leg length is equal)
357	The Ilizarov-apparatus is removed
376	First follow-up examination
414	Second follow-up examination, patient works half-time as a fisherman
1087	Final follow-up, patient works full-time as a fisherman

Discussion

The only other alternative to close the soft-tissue defect would be the use of a free muscle flap, which is technically demanding, but a reliable solution (Gooden et al. 1997). An alternative treatment of the defect in the extensor muscles and anterior tibial tendons could have been a tendon transplant (Hahn and Kim 1991). However, this requires a donor site and would have to be performed much later in the course of treatment.

Alternative solutions to bone lengthening could be an autogenous bone graft, used after resection of bone tumors (Enneking et al. 1980, Johnson et al. 1988), or vascularized fibular grafts, which have been successful in the treatment of bone defects occurring after osteomyelitis (Yajima et al. 1993). In all these techniques, an active infection is a contraindication. Furthermore, the period of treatment is longer, and the techniques are more time-consuming, as regards surgery and inpatient stay.

The protracted treatment with the Ilizarov apparatus can be uncomfortable and distressing for the patient. As reported by Paley (1991), the patient must be prepared for pain and disturbed sleep, etc.

Amputation is a final solution for these major injuries and should be considered, if the patient does not appear to have sufficient personal resources to go through with the course of treatment or if the leg will be barely functional and a constant source of pain (Attinger 1995). Distraction osteogenesis and transplant with a free muscle flap have reduced the number of amputations after major bone- and soft-tissue defects, as well as reduced the length of treatment (Cierny and Zorn 1994). The many advantages of the circular frame were ideal in the treatment of our patient as regards both distraction osteogenesis to treat the bone defect, and the treatment of skin, muscle and tendon defects with distraction histiogenesis.

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