



Ilizarov method as limb salvage in treatment of massive femoral defect after unsuccessful tumor arthroplasty

Primena aparata prema Ilizarovu za spasavanje noge u lečenju masivnih defekata butne kosti nakon neuspešne tumorske artroplastike

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Abstract

Introduction. Surgical management of massive bone defects is very challenging in terms of estimating possibilities of saving the extremity and adequate method that can make it possible. Selection of methods is additionally limited in the presence of infection at site of defect. **Case report.** The female patient, diagnosed with Ewing sarcoma was treated by segmental bone resection and implantation of Kotz modular tumor endoprosthesis. After 5 years the signs of infection occurred and persisted with low grade intensity. After falling, 12 years following implantation, the patient acquired periprosthetic fracture. Then endoprosthesis was removed, all along with surgical debridement of wound and application of the Ilizarov apparatus. The apparatus was applied, osteotomy of callus and the tibia performed with transport of bone segments, until reconstruction of defect and arthrodesis of the knee was achieved. **Conclusion.** The Ilizarov apparatus offered us huge possibilities for management of massive bone defects with natural bone which has superior biomechanical characteristics comparing to the implant. The most frequent complication of this method is a prolonged treatment period that demands good patient selection and preparation and wide surgical experience.

Key words:

sarcoma, ewing; femur; infection; fractures, bone; ilizarov technique; treatment outcome.

Apstrakt

Uvod. Hirurško zbrinjavanje velikih defekata kostiju stavlja hirurga u veliko iskušenje u pogledu procene mogućnosti spasavanja ekstremiteta kao i primene adekvatne metode kojom će to učiniti. Izbor metoda je dodatno ograničen kod postojanja infekcije na mestu defekta. **Prikaz bolesnika.** Kod bolesnice zbog Ewing-ovog sarkoma učinjena je resekcija tumora i implantacija tumorske endoproteze Kotz. Posle pet godina javili su se znaci infekcije niskog intenziteta. Nakon 12 godina, bolesnica je pri padu zadobila periprotetski prelom kada je odstranjena endoproteza, učinjena hirurška obrada i postavljen aparat prema Ilizarovu koji je, uz menjanje konstrukcije i dodatne operacije, nosila do potpune nadoknade defekta i postizanja artrodeze kolena. **Zaključak.** Aparat prema Ilizarovu pruža velike mogućnosti nadoknade defekta prirodnom kosti koja ima superiorne biomehaničke karakteristike u odnosu na implantat. Najčešća komplikacija ove metode je produženi period nošenja, što zahteva dobru selekciju i pripremu bolesnika, kao i veliku veštinu hirurga.

Ključne reči:

sarkom, juingov; femur; infekcija; prelomi; metod ilizarova; lečenje, ishod.

Introduction

Ewing sarcoma is a highly malignant tumor. In most cases its origin is in bone tissue (approximately 10% origina-

tes from tissues that are surrounding bone)¹. Population younger than 30 years is usually affected². The fact that almost 25% of this tumor are metastatic at the diagnosis time is one of the biggest problems in successful treatment³. For a

long period amputation surgery was the only treatment for this pathology. The first announcement of possible new treatment option was made in 1950 when Buchanan⁴ introduced total femur replacement. First results of reconstructive surgery were controversial comparing to amputation, a standard procedure for this pathology at that time⁵. The cardinal reason for this was a high frequency of tumor recidives. Together with improvement of adjuvant chemotherapy and advancement in endoprosthesis design limb salvage surgery has been established as standard in this area of orthopedic oncology^{6, 7}. A specter of new complications arises comparatively with this procedure with infection and residual bone defects among most frequent ones.

There are few available options for treatment of this complication with its benefits and imperfections. One of those, used with a significant success is the Ilizarov method. First attempts of external or extrafocal fixation originated from the first half of 19th century and were represented by a work of Malgaigne in 1843⁸. In 1966 Russian physician Ilizarov introduced a new method of reconstruction of defects of long bones based on *de novo* bone formation between bone segments created by osteotomy and their latter graduated distraction. The osteosynthesis process is performed in two manners, by bilocal synchronized compressive distraction or by alternate distraction compressive osteosynthesis⁹. At the very beginning of external fixation, the Ilizarov major aim was treating of bone infection ensued after fracture¹⁰. He was first who described the influence of exerted distraction in the processes of osteogenesis and suppression of tissue inflammation reaction without use of antibiotics.

Case report

At the age of 18 the patient was diagnosed with Ewing sarcoma. The patient was treated surgically by segmental resection of the femur and reconstruction of the distal femur with the Kotz type of modular tumor endoprosthesis. Five

years afterwards, the signs of low-grade infection occurred (secretion from wound and local redness). This was treated by occasional peroral antibiotic therapy in addition to which infection persists. Twelve years following implantation, after falling, the patient acquired a periprosthetic fracture of the proximal femur and was referred to our hospital for the first time. After clinical processing was completed, we ascertained periprosthetic fracture and the presence of fistula with low secretion of serous pus content. Laboratory parameters for infection as well as culture results of smear were negative. As there were data about a long history of infection and significant wound secretion earlier, we decided to perform extraction of endoprosthesis and surgical debridement. Intraoperatively, we found a small amount of pus and intraoperative culture was negative. Postoperatively, the leg was immobilized with coxofemoral immobilisation. Antibiotic therapy was administered by the protocol that was applied at that time and, meanwhile changed a lot. It consisted of the 3rd generation of cephalosporin intravenously for 10 days and continued with peroral antibiotics for 21 day. Afterwards, the patient tried to manage further medical treatment in the Ilizarov Center in the city of Kurgan, Russia, but after some time changed her mind and continued with treating at our Clinic.

Before surgery, new x-ray was obtained and healing of the fracture of the proximal femur was found. Femoral defect was estimated approximately 15 cm (on x-ray) relative shortening, while clinical (absolute) shortening of the leg was about 22 cm. After 6 months without clinical and laboratory signs of infection the Ilizarov apparatus was positioned on the thighs and lower leg, corticotomies of the tibia and fibula performed as well as osteotomy of a callus of the fractured fragment of the proximal femur. Then we started with simultaneous transport of a free femoral fragment and distraction of the lower leg aiming at arthrodesis of the knee. The dynamics of fragment transport and distraction was 0.5 mm *per* day (Figures 1 and 2). Occasionally, we noticed cut-in of a K wire through skin and consecutive minimal skin necrosis

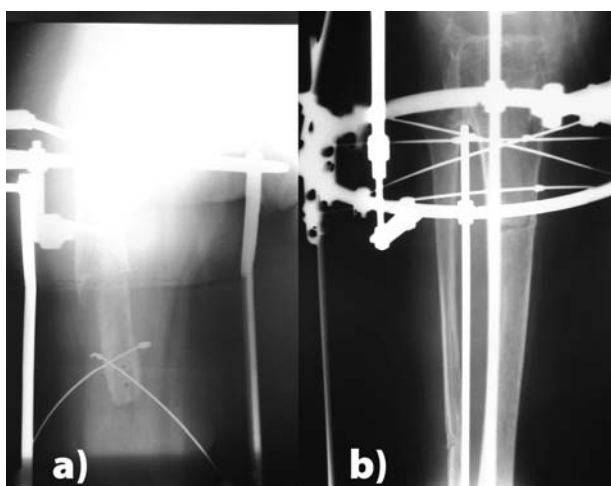


Fig. 1 – Osteotomy of calus performed, also corticotomy of tibia and fibula: transport started [a) antero-posterior radiograph; b) profile radiograph].



Fig. 2 – Transport of bone segments-noticeable regenerate.

which was treated by local wound cleaning and healed *per secundam*. Ankle distraction resulted in contracture, as well as equinus foot deformity, that are frequently reported as complications of this method, so we removed this construction after 6 months. Then we performed Achilles tendon elongation (Hoke) and placed construction for correction of equinus deformity. As fractured femoral fragment transport was finished, with good bone regenerate forming, two hoops were placed on the distal femur and adequate construction of the lower leg in order to apply compression and achieve arthrodesis of the knee. This was enhanced with patellar autologous bonegrafting. This construction was successful for correcting foot deformity and Achilles tendon elongation, but unsuccessful about knee arthrodesis. After 8 months we estimated that the existing bone quality was not good for a new Ilizarov construction, so we removed the existing one and put immobilisation, that was used for next 2 years. Then, in agreement with the patient, a new construction was positioned, accompanied with osteoplastics with allografts, bone ends refreshing and graduate compression, so we reached arthrodesis in 5 months (Figure 3). After finishing surgical treatment, residual leg shortening was 1.5 cm, the patient walked without using any tool, with no pain in everyday activities. The patient restored the same level of activities as before the failed arthroplasty. Ankle function was excellent, with submaximal range of movement and no pain (Figure 4).



Fig. 3 – Arthrodesis of the knee achieved (Ilizarov apparatus removed).

Discussion

Managing the presented patient, the surgeon was in enviable position and in a great dilemma choosing the therapeutic approach. Amputation was a possible option, with the possibility for quick rehabilitation. As the patient was young, with no complications of primary pathology, and highly motivated for reconstructive surgery, it was decided to use the experience with the Ilizarov technique and attempted to manage the existing defect with bone transport and distraction

with final knee arthrodesis. The patient was acquainted with the inevitable long period of treatment, as well as with the possibility of other complications.

Surgical treatment of bone defects following trauma, tumors, infections, failed arthroplasties or congenital anomalies can be performed with different methods: free bone grafts, vascularized fibular grafts, custom made endoprosthesis and artificial bone substitutes. There are advantages and imperfections of each of these methods regarding defect size that can be managed, percentage of nonunion, mechanical strength, donor site comorbidity and surgeons experience that is needed^{11–14}. Autologous bone grafts can be used in treating smaller defects. Vascularized fibular grafting is an extremely technically demanding procedure and there are reports of significant incidence of pseudoarthrosis and nonunions. Song et al.¹⁵, published a study that suggested advantage of bone transport comparing to vascularized fibular graft when it come to functional results.

The Ilizarov method of osteodistraction is a reliable method for managing defects larger than 8 cm¹³, like the one we had to deal with. The most frequently reported complications of this method are a prolonged period of treatment and pin tract infection^{16–18}. Some authors suggest intramedullary nailing and bone transport over nail for the reduction of treatment time^{19–21}. There is a widely accepted opinion that pin tract infection is successfully managed by local wound toilette, antibiotics admi-



Fig. 4 – Patient 24 months after apparatus was removed.

nistration and, eventually correction of needle position^{16, 17, 22, 23}. One of the most frequently reported complications of this method is docking site fracture in 25% of patients^{24, 25}.

Principal advantage of distraction osteogenesis is the possibility to achieve regeneration of live bone that has the same or closely same strength like former bone, with the possibility of live tissue to adopt for mechanical loads in future.

Difficulties we dealt with during treatment of the presented patient are the most frequent complications of the Ilizarov method in general. At the planning phase and during

the treatment, possibilities that could reduce treatment time were considered, but we thought none of them could successfully be applied in this case. We deem that key factors for the success in such a long treatment are patient cooperability and a good relation between a patient and the doctor. If we take a look on economical side, initial expenses for amputation are much lower, but projected expenses of lifetime prosthetic works are larger^{26, 27}.

Conclusion

The Ilizarov method is an excellent choice for managing massive bone defects accompanied with local infection. A principal disadvantage is a prolonged treatment time, that demands good selection and preparation of patients. It is very important to mention a long learning curve and the need to plan the well-timed education.

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