DEFINITE MANAGEMENT OF BILATERAL LOWER LEG NONUNION FRACTURES BY ILIZAROV APPARATUS IN POLYTRAUMATIZED PATIENT – CASE REPORT

Ivica LALIĆ1, Mirko OBRADOVIĆ1, Mirka LUKIĆ ŠARKANOVIĆ2 and Vladimir ĐAN3

Summary

Introduction. Nonunion of long bones may often be associated with significant function loss of affected extremity, joint stiffness, and even extremity amputation or systemic manifestations in the case of infection. The aim of this case report is to highlight the possibilities of Ilizarov apparatus in the treatment of fracture nonunions of both lower legs treated by different operative methods and to show that it is not necessary to remove osteosynthetic material (intramedullary nail) in every case when nonunion occurs to achieve its recovery. Case Report. A 62-year-old man was injured in a traffic accident as a pedestrian in April 2012, when he experienced polytrauma, including shaft fracture of the right femur, and segmental open fractures of the right (Gustillo-Anderson grade I) and left (Gustillo-Anderson grade II) lower leg. The fractures of right femur and right tibia were stabilized initially with intramedullary nails, while the left lower leg fracture was treated by unilateral external fixator. After 5 months, there were no clinical and radiographic signs of union on lower legs, therefore the patient underwent re-surgery. Ilizarov apparatus was applied on both lower legs. The patient was early verticalized and both apparatus were removed after 4 months. According to the modified protocol of the Association for the Study and Application of Methods of Ilizarov, the lower leg bony results were good and excellent, and the functional results were excellent on both sides. Conclusion. Nonunion fracture of the right lower leg initially treated by the method of intramedullary osteosynthesis and afterwards by placing Ilizarov apparatus shows that in some cases it is not indicated to remove fixative material in order to achieve full recovery of fracture, thus eliminating the danger of all negative effects resulting from the classical extensive surgical treatment. Key words: Tibial Fractures; Fractures, Ununited; Ilizarov Technique; Clinical Protocol; Multiple Trauma; Treatment Outcome

Sažetak


Corresponding Author: Prim. asist. dr Ivica Lalić, Klinika za ortopedsku hirurgiju i traumatologiju, 21000 Novi Sad, Hajduk Veljkova 1-7, Serbia, E-mail:laleort021@gmail.com
Abbreviations

ISS = injury severity score

inflammatory mediators and loss of mobility of the injured patient, with all the negative, resulting consequences (aggravated management of the injured patient, venous thrombosis and hypostatic pneumonia due to inactivity and prolonged lying), treatment of polytraumatized patients with fractures of the tibia is a very complex problem [4]. Tibial shaft fractures are the most frequent type of long bone fractures treated by orthopedic surgeons. The incidence in general population is approximately 26 fractures per 100,000 [5]. The introduction of dynamic compression plates by Association for the Study of Internal Fixation (AO) led to popularization of open reduction and internal fixation (ORIF) [6]. In recent years, plates with less peristomal contact have been developed [7]. Intramedullary locking nails represented a revolution in the treatment of tibial shaft fractures [8]. One of the advantages of Ilizarov external fixation is the possibility of early weight bearing on the operated limb. [9] Ilizarov method has also proved to be a successful choice in treatment of tibial fracture nonunion, especially after failure of other methods [9]. Intramedullary nailing combined with grafting and the Ilizarov apparatus compression and distraction techniques were used for the treatment of nonunions, pseudoarthrosis and bone defects. A similar technique was reported by Giebel [10] and popularized by Salis de Gauzag et al. [11] although we did not use grafting and distraction. This case report is aimed at highlighting the possibilities of Ilizarov apparatus in the treatment of nonunion fractures of both lower legs treated by different surgical methods. In addition, it should be said that it is not always necessary to remove osteosynthetic material (intramedullary nail) when nonunion occurs to accomplish the recovery of fracture.

Case Report

A 62-year-old man was injured in a traffic accident as a pedestrian in April 2012. Having been given first aid and immobilized, he was transported to the emergency room. Clinical examination, laboratory, radiographic and computed tomography findings indicated the following injuries: multiple lacerococuntosions of body, seven fractured teeth, commotion syndrome, the right femur shaft fracture, segmental open fractures of the right (Gustillo-Anderson grade I) and the left (Gustillo-Anderson grade II) lower leg (Figure 1), liver rupture, gallbladder hematoma, intra-abdominal bleeding. Injury severity score (ISS) was 29. After extensive preparative preparations, the first surgery, performed in general anesthesia, was focused on intra-abdominal bleeding and drainage of abdominal cavity as well as primary surgical treatment of wounds. For all fixation procedures, an x-ray image amplifier (“C-arm”) was used. After orthopedic reduction of the right femur and intramedullary fixation with retrograde nail (S2™, Stryker, Montreux, Switzerland), segmental fracture of right leg was stabilized with intramedullary nail (Versanail™, DePuy, Leeds, England). Finally, stabilization of segmental fracture of left lower leg was performed after orthopedic reduction and fixation using external fixator by Mitkovic (Trafix®, Niš) with two convergently set nails in each tibial segment (six in total). A good position of fragments of segmental fracture on the left lower leg was achieved; however, it was seen that the right leg tibia was shorter by 1 cm (shortness of tibial length of 1 cm was observed on the right leg), noticeably passing of proximal fibula with preservation of tibial axis which was also verified by standard radiography postoperatively (Figure 2). The patient was then transferred into the intensive care unit. After stabilization of vital parameters, the patient was transferred to the Department of Orthopedic Surgery and Traumatology. All measures of early rehabilitation were performed. The patient was discharged from hospital in good general condition and advised on the wound management and consolidation. However, control radiographs within the outpatient department checkups showed healing of the fracture on the right femur, but not union of both, left and right lower leg fractures (Figure 3). A free bone fragment, which raised the skin not allowing interfractionary contact of proximal and distal part of tibia, was visible on the right lower leg. Dislocation in proximal segment occurred on the left lower leg despite the corrections of external fixator. The patient’s verticalization was practically impossible and any attempt of weight bearing on lower extremities was very painful. Limitation of movement was present on both sides in the knee joint. Having been informed on the possible surgical treatment on lower legs, the patient gave his consent and was hospitalized again in September 2012. After preoperative preparation, the first external fixator was removed.

Figure 1. Open segmental fractures of right and left lower leg

Slika 1. Otvoreni segmentni prelomi desne i leve potkolence
from the left lower leg, osteotomy of proximal fibula was performed and Ilizarov apparatus was applied with four frames attached to each other by threaded rods. Olive pins were used only. A free bony fragment from anteromedial part of right tibia, irregularly shaped, sized 1x2 cm, which in transverse plane made up to the 1/3 of tibial circumference, was placed between the nail and the proximal tibia, and since it did not allow the proper contact between the fragments, it was removed. The proximal transfixation nail screw was removed, osteotomy of proximal fibula was performed and Ilizarov apparatus was set with four frames attached to each other with threaded rods. Olive pins were introduced transcortically near the intramedullar nail (Figure 4). Interfragmentary compression was performed on the second postoperative day on both legs, and remained for a total of 10 days with dynamic of 1 mm per day. The patient underwent intensive early rehabilitation program and verticalization started immediately. The full weight-bearing was allowed on the second postoperative day, while the full weight-bearing on the left leg was allowed 10 days after surgery (Figure 5). No signs of pin tract infection were noticed; however, four pin site infections developed, which were successfully treated with oral antibiotics and wound management. During his stay in hospital, the patient underwent intensive kinesiotherapy and magnetic therapy. After discharge, the patient came for regular checkups and the healing of both lower legs was monitored radiographically. Outpatient physical procedures were applied to achieve the rapid recovery of both tibias. The apparatus was removed from the right lower leg in December 2012 and the full weight bearing was allowed. In February 2013, the apparatus was removed from the left lower leg and a protective upper leg cast was set and the patient wore it for two weeks. The full weight bearing on the left leg was allowed four weeks after the removal of Ilizarov apparatus. After this, the patient was treated in a spa for two months. On the outpatient department checkup in December 2013, the complete healing of segmental fractures of both lower legs was radiographically confirmed (Figure 6). The range of knee and ankle joints motions was measured: the left knee joint flexion was 130 degrees, the right knee flexion was 120 degrees; the right ankle – plantar flexion was 40 degrees, the dorsal flexion was 15 degrees; the left ankle – plantar flexion was 35 degrees, and the dorsal flexion was 20 degrees. Neither any signs of infection nor any lesions of fibular nerves were observed. The right lower leg was measured to be shorter by 1.5 cm and the patient compensates it by wearing an insert in the right shoe. Valgus position of left lower leg of 10 degrees did not affect normal gait and occurrence of pain in ankle joint. The patient was followed for two years in total. He returned to his life and work activities fully recovered.

Discussion

In our case, the risk for nonunion occurrence was high as correctly determined by ISS which was 28. In polytraumatized patients with ISS ≥16, fractures are often treated by methods inappropriate for that type of fracture, which can further worsen prognosis of these fractures, particularly if they are accompanied by a significant soft tissue lesion [12]. Treatment of atrophic nonunions is aimed at restoring osteogenic activity at the fracture site, which can be achieved by resection of fibrous tissue within the fracture site and implantation of an autograft, and if there is instability, osteosynthesis revision

Figure 2. External fixation of left tibia and intramedullary osteosynthesis of right tibia

Figure 3. Right lower leg fracture nonunion with loose fragment, and left lower leg fracture nonunion

Figure 4. Left and right tibia osteosynthesis using Ilizarov apparatus

Figure 6. Range of knee and ankle joint motions measurement

Figure 5. No signs of pin tract infection were noticed; however, four pin site infections developed, which were successfully treated with oral antibiotics and wound management.
management of bilateral lower leg nonunion fractures should be made [13]. Surgery for nonunion is often very difficult and many complications may occur. Available definitions of nonunion are various, inconsistent and arbitrary and can be interpreted subjectively. There are several time points that have been recognized as parameter of nonunion, ranging from 20 to 26 weeks [14]. Food and Drug Administration (FDA) of the United Stated of America defined nonunion as the absence of radiographic healing 9 months after injury [15]. We have decided to accept a new definition, which describes nonunion as the absence of progressive signs of healing on radiographs for 3 consecutive months [16]. Because no clinical or radiographic evidence of healing was recorded, we have decided to perform reosteosynthesis. Partial fibulectomy was described as a useful part of tibial nonunion surgery [17]. This procedure is usually performed on a level different from nonunion to avoid tibial destabilization [18]. We performed bilateral partial fibulectomy above the levels of nonunion. As the Ilizarov frame disabled translational movement of fragments, combination of axial compression and partial fibulectomy proved to be a great tool for nonunion treatment. There are numerous Ilizarov methods for high-energy tibial fracture treatment [19] in order to achieve union, deformity correction, soft tissue healing and limb alignment. Whatever method is used, nonunion and infection are still frequently recorded [20].

The vascularity of the nonunion is one of determining factors in bony healing because vascular or hypertrophic nonunions present a smaller treatment problem than atrophic nonunions [21]. The common aims of treatment are to correct axial or rotational malalignment, equalize extremity lengths, prevent or treat infection, and allow functional restoration of the limb [22]. Generally, good results have been seen in the treatment of tibial nonunions with small-wire circular frame devices. Paley et al. [23] reported a 100% union rate in 25 patients treated with the Ilizarov apparatus for tibial nonunions with segmental bone loss. In 197 patients with various types of open tibial fractures, treatment was initially performed using unilateral external fixation. Healing was achieved in 61% of cases. The remaining 39% of patients were treated with intramedullary nail (17%), Ilizarov apparatus (13%) and Sarmiento cast (9%), which eventually led to the complete union [24]. Stoljeković et al. used internal fixation with selfdynamisable internal fixator as a re-osteosynthesis method in 6 polytraumatised patients, thereby achieving union in 83% of patients [25]. Revision osteosynthesis in our case was done by Ilizarov external circular fixator, which resulted in fracture healing. Ebraheim et al. [26] found 89% union rate in nine patients treated for tibial nonunions with angular deformity. Laursen et al. [27] reported a 94% union rate in 16 patients treated with the Ilizarov fixator for complex tibial nonunions, with limb-length discrepancy reduced to within 1.5 cm of the contralateral leg. According to the Association for the Study and Application of Methods of Ilizarov (ASAMI) classification, excellent bone and functional results were achieved despite shortening of the
right leg, while on the left leg, excellent bone and functional results were observed despite angular valgus deformity of 10 degrees. Sanders et al. [28] reported ankle pain as a major disability after the application of the Ilizarov fixator for tibial nonunion. We have not had this problem when applying the Ilizarov method. In a series of 390 patients with fractures of the tibial shaft treated with intramedullary osteosynthesis, of which 79% were closed, and the remaining 21% open, union was achieved in 98% of cases, while in the remaining 2%, nonunion or pseudoarthrosis was recorded. In 5 fracture nonunion revisions, intramedullary nailing was performed, while pseudoarthrosis was treated by Ilizarov transosseous osteosynthesis, which resulted in complete union [29]. Gulabi et al. reported five patients with nonunions, which had previously been treated with different methods. His treatment of choice was intramedullary nailing combined with bone resection, compression and distraction of the Ilizarov apparatus and autografting at the docking site. The grafts were harvested from the iliac crest [30]. In our case, the nail was already placed inside the bone. We removed the loose bone fragment and the proximal transfixational screw. We then placed the Ilizarov apparatus in order to apply compression and achieve rotational stability of the tibia. In our case, there was no pin-site and pin-track infection and we removed the Ilizarov apparatus after three months. Early removal of the external fixator reduces the risk of pin-site infection and allows earlier rehabilitation of the patient [31]. So far, no studies or case reports have been published on this subject in the Serbian Citation Index. International literature offers articles that describe the combination of intramedullary nails and apparatus but only in cases of treatment of congenital pseudoarthrosis of the tibia [32] and lengthening of the tibia in infected fracture nonunions and segmental defects [33]. Transcortical placing of pins without nail removal has reduced the risk of infection, new distribution of intramedullary vascularity, and by removing proximal transfixation nail screw and continuous compressive effect on bone, we achieved the complete bone recovery and the full weight-bearing which is important in process of recovery and rehabilitation. The stability of apparatus was not disturbed by transcortical introducing of pins which is not characteristic for this (transosseus) method of treatment. The Ilizarov techniques have shown to be useful in the management of difficult fractures and nonunions of the tibia but practicing surgeons call attention to their main drawbacks such as the long time the patients have to spend with the fixator on, much discomfort, and pin tract infections [34, 35]. Therefore, the techniques that combine the external device with intramedullary nailing have been advocated to avoid these problems. The combined techniques resulted in the reduction of the usual Ilizarov external fixation duration and good union rates [34–36]. Popkov et al. [37] conducted a study which was aimed at revealing the differences in radiographic and histological outcomes of bone repair by using flexible intramedullary nailing combined with the Ilizarov external fixation versus the Ilizarov external fixation alone on a canine model of an open diaphyseal tibial fracture. They have concluded that their experimental study proves that the combination of the Ilizarov apparatus and flexible intramedullary nailing augments fixation stability of bone fragments, accelerates the repair of tibial shaft fractures, and can be used in clinical settings. This combined technique does not contradict the biological principles of the Ilizarov method.

**Conclusion**

In our case, the polytraumatized patient had fractures of both lower legs, which later led to nonunion, so Ilizarov external fixation method proved to be a method of choice as it enabled early weight-bearing and rehabilitation. Treatment of tibial nonunion by using the technique that combined intramedullary nailing and Ilizarov apparatus proved to minimize angulation and malalignment, also allowing further mobilization and return to daily life. We think that the presentation of this case may be of use for orthopedic surgeons—traumatologists by suggesting how to solve complicated fractures of extremities without removal of hardware as well as providing full weight bearing on both extremities, which contributes to the rapid recovery.

**References**


