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*Case report* ■

# Lower Leg Severe Open Fracture Caused by Traffic Accident - Treatment by External Skeletal Fixation: Case Report

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**SUMMARY**

**72 years-old woman suffered an open fracture of the right tibia, as a pedestrian, when the bus tires crossed over the right foot. She was immediately transported to the Clinical Center Niš and following clinical examination, the amputation of the lower leg was advised due to extensive injury. On admission to the hospital (Clinic for Orthopedics and Traumatology), after resuscitation, arteriography of the blood vessels of the right leg was performed. Spasm of blood vessels of the right leg below the fracture was noted, but the circulation in the distal part of the lower leg and foot was preserved. After removing temporary immobilization and bandage of the lower leg, a large wound was noticed, from the toes to the popliteal crease. Primary treatment of the wound was done and tibial fracture was stabilized with external fixation (with convergent orientation of the pins). Almost the whole wound was left open, while the vital structures of the leg (the main blood vessels and nerves) were covered with local soft tissues that are adapted by situation sutures. Due to the large soft tissue destruction on the right lower leg and diabetic angiopathy, the patient was sent to special orthopedic hospital "Banjica" in Belgrade. After repeated wound debridements, external skeletal fixator was removed and the Ilizarov apparatus was placed. Soft tissue defect was covered by skin graft. In the postoperative period, patient was regularly dressed. Eight months later, the fractured tibia healed and the Ilizarov apparatus was removed. The patient was referred for rehabilitation. Following rehabilitation, patient returned to her work and everyday activities.**

***Key words:*** **fracture of the lower leg, primary wound treatment, external skeletal fixation, Ilizarov apparatus**

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## INTRODUCTION

Because of its location and its importance, the lower leg is often exposed to injuries, which might be caused by traffic accidents or any other kind of damage. Open tibial shaft fractures are among the most serious injuries of the lower leg (1, 2). They are caused by direct force effect. Direct mechanism of injury can be usually seen in traffic accidents (car collision). Under the influence of a strong force, there is a severe damage of soft tissues, in addition to bone fractures, and, through the open wound, a broken bone fragment usually communicates with external environment. Because of that, these fractures are primarily contaminated. Destruction of soft tissue, expressed comminution or loss of bone tissue and threatening infection make treatment of open tibial shaft fractures rather difficult and complex (3, 4). Treatment of the lower leg fractures is followed by a number of threatening complications, including: soft tissue infection around fracture site and deep bone infection – osteitis, fracture disunion and amputation of the lower leg (5).

The most important thing in treating patients with open tibial shaft fractures is the choice of treatment, ie. proper indications for treatment. Successful treatment of these fractures depends on: severity of the injury, state of the injured limb's neurovascular system, the patient's general condition and associated injuries, as well as the applied methods of treatment (6).

The aim of our paper was to present the result of treatment of open tibial shaft fractures in a patient, injured as a pedestrian in a bus collision, who was treated at the Clinic of Orthopedics and Traumatology, Clinical Center Niš.

## CASE REPORT

72-year-old woman was admitted to the Emergency Surgical Unit of the Clinical Center Niš, with severe traumatic shock and open fracture of the right lower leg. She suffered traffic accident as a pedestrian, when the bus tires crossed over the right foot. Immediately upon admission, intensive resuscitation was started. After removing the temporary immobilization and bandages, open fracture of the right lower leg and the wound were noted, which extends from the toes to the popliteal pit (Figure 1).

After clinical examination, the amputation of the right lower leg was indicated and the patient was referred to the Clinic of Orthopedics and Traumatology, Clinical Center Niš. On admission to hospital, after resuscitation of the patient, arteriography of the right leg was done. Right lower leg arteriography showed the spasm of blood vessels distal to the fracture site, but no lesions of main arteries on the right leg (Figures 2 and 3).

After a brief preoperative examination and preparation, the wound was washed extensively and foreign bodies were removed from the wound (Figure 4).

After meticulous removal of foreign bodies from the wound and abundant rinsing, debridement of the lower leg wound was done (from the surface to deeper layers of the wound). All avascular and necrotic tissues were removed. Then, the reposition of the tibial fracture fragments and the external skeletal fixation was performed (Figures 5 and 6).

In the postoperative period, X-ray images of the right lower leg were made with the right leg ankle in the AP and LL projections (Figure 7).

The wound was largely left open, while the vital structures of the leg (the main blood vessels and nerves) were covered with soft tissues adapted by situational sutures (Figure 8).

Early postoperative course was usual with daily dressings of the wound (Figure 9).

Due to the large soft tissue destruction on the right leg and diabetic agiopathy, the patient was sent to special orthopedic hospital "Banjica" in Belgrade for further treatment. After repeated wound debridements, external skeletal fixator was removed and the Ilizarov apparatus was placed. Soft tissue defect was covered by skin grafts (Figure 10).

After the Ilizarov appliance was placed, the compression on the fracture site was started. The patient was returned for further treatment in the Orthopedic Clinic, Clinical Center Niš, where we continued with regular daily dressings around pins. Five months after sustaining the injury the control X-ray of the right lower leg and ankle joint was made (Figure 11).

Eight months after sustaining the injury the fracture healed and the Ilizarov apparatus was removed. X-ray of the lower leg and ankle was made (Figure 12).

For further treatment the patient was referred to rehabilitation. Upon completion of rehabilitation she returned to her regular life and work activities and could walk without crutches.

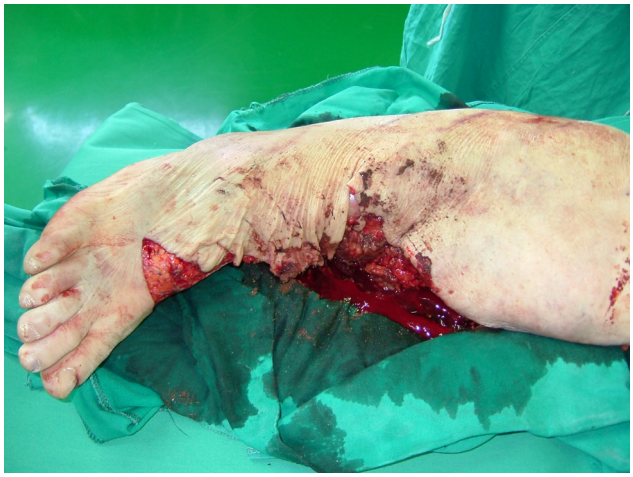

***Figure 1.*** *The appearance of the right leg after injury (bus tires ran over the foot)*

***Figure 2.*** *X-ray of the right tibia and fibula fracture in the middle and distal third of the lower leg, and fracture of lateral maleolus of the right ankle in the AP projection*

***Figure 3.*** *Right lower leg arteriography showing spasm of blood vessels distal to the fracture site, but no lesions of the main arteries on the right leg*

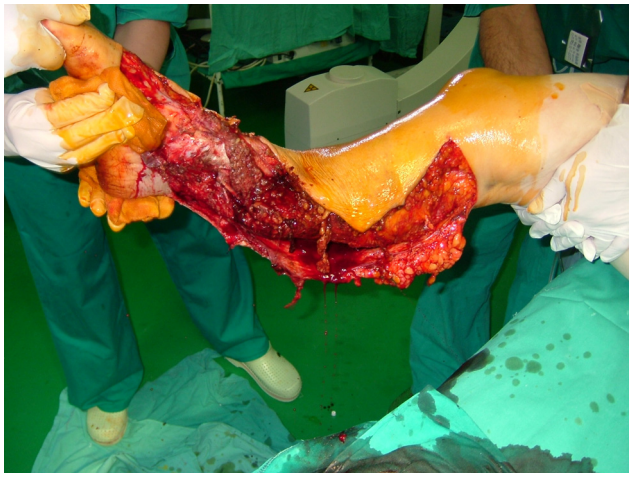

***Figure 4.*** *The appearance of open right leg fracture during the early cleansing and washing and removal of foreign bodies, soil and gravel from the wound*

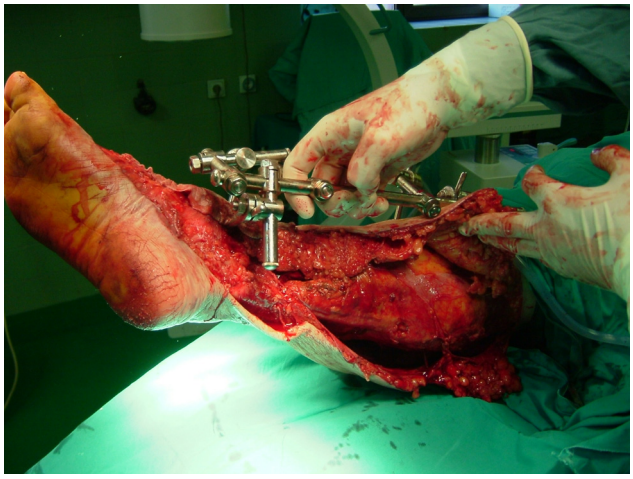

***Figure 5.*** *The proximal part of the open right tibial shaft fracture, after debridement and external skeletal fixation*

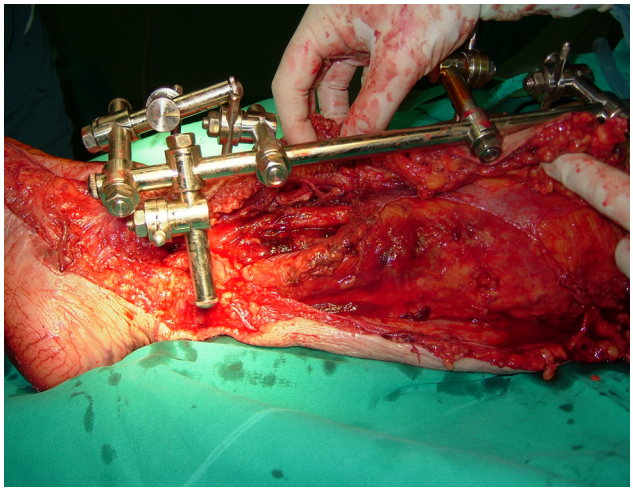

***Figure 6.*** *The distal part of the open tibial shaft fracture wound. Arterial blood vessels and bone fragments can be seen in the depth of the wound*

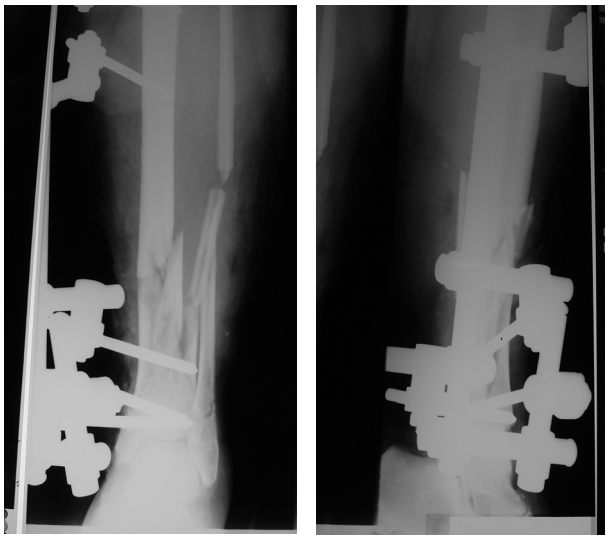

***Figure 7.*** *On the X-ray recordings of open tibial shaft fracture of the right lower leg, a good reposition of broken fragments of the right tibia can be seen, which are stabilized by external skeletal fixation*

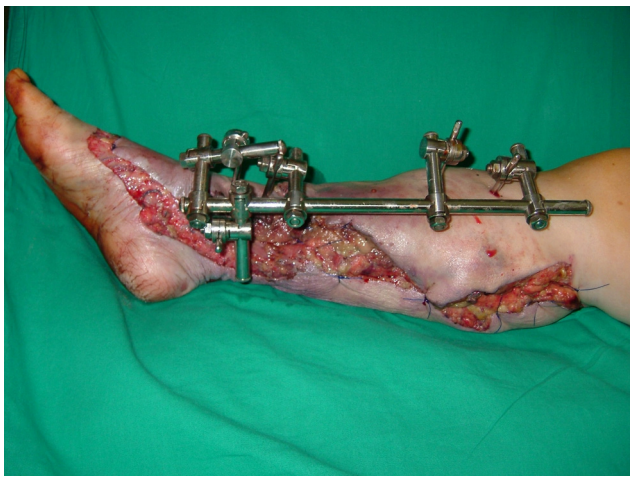

***Figure 8.*** *The wound is largely left open, while the vital structures of the leg (the main blood vessels and nerves) are covered with soft tissues adapted by situational sutures*

***Figure 9.*** *Early postoperative course was usual with daily dressings of the wound*

***Figure 10.*** *The appearance of the right lower leg after placement of the Ilizarov apparatus and after skin grafting*

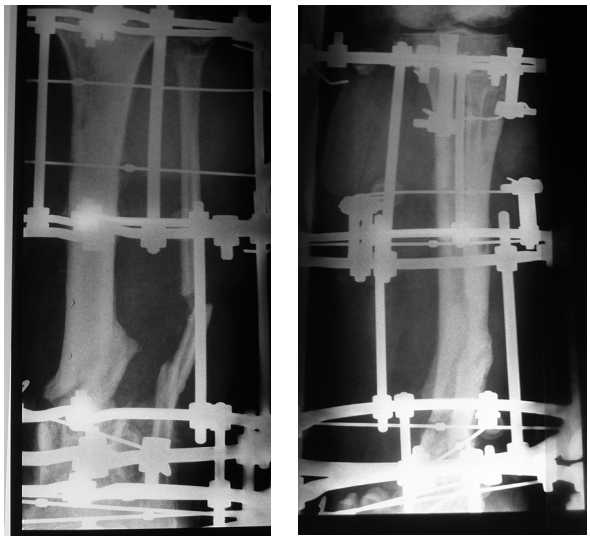

***Figure 11.*** *On the X-ray recordings of the right lower leg and ankle made in the AP and LL projections, the broken right lower leg in the healing phase stabilized with external skeletal fixation can be seen*

***Figure 12.*** *On the X-ray recordings of the right lower leg and ankle,after removal of the Illizarov apparatus, the helaed fracture of the right lower leg can be seen. Relations in the right ankle are good*

## DISCUSSION

Open fractures of the lower leg usually occur in traffic accidents (under the influence of strong, violent force); often, they are the consequence of industrial traumatism and injuries in agriculture. Open fractures are considered to be primarily contaminated because the fracture site communicates with the external environment. Treatment of these kinds of fractures includes: extensive primary debridement of open fracture wounds, fracture stabilization, antibiotic therapy, antitetanus protection and delayed wound closure (6).

Open fractures of the lower leg require urgent surgical treatment as soon as the patient's condition allows it. Primary treatment of open fracture wounds should be done in the first six hours after sustaining an injury, if possible. "The rule of six hours," reduces infection according to studies of Kindsfatera and Jonassen (7) and Kreder and Armstrong (8) conducted in 1995. Six hours after sustaining the injury, there is an expansive growth of microorganisms and their binding to the damaged lower leg tissue. Avascular, necrotic tissue of the lower leg represents a good basis for expansive growth of microorganisms. However, other contemporary studies bring the rule of "six hours" into question. Bednar and Parikh (9) and Speneser (10) found no significant statistical difference in the percentage of infection in open fractures treated surgically before and after six hours of sustaining an injury.

Early intravenous antibiotic therapy in open tibial shaft fractures reduces infection rate and should be initiated immediately upon patient admission to the hospital (11). Cefazolin, which „covers“ a group of Gram-positive bacteria should be administered to all open fractures. Aminoglycosides, covering a group of Gram-negative bacteria, are necessary for open fractures with large soft-tissue injuries and extensive contamination. Penicillin, covering anaerobes, is required when there is a possibility of wound contamination with anaerobic microorganisms, which is common in open tibial fractures sustained during agricultural activities, when the wound is usually contaminated with soil. Antibiotic therapy should be continued for the next 48 to 76 hours (in open tibial fractures, grade I and II), whereas in grade III open tibial fractures it may be extended up to 120 hours (following meticulous debridement of an open fracture wound) (2).

Primary surgical treatment of the wound (debridement) is an important factor in the prevention of osteitis, gas gangrene and tetanus (5). Before wound debridement, it is necessary to cleanse the wound thoroughly and remove all foreign bodies from the wound (soil, parts of plants and clothes, etc.). For cleaning the wound in open tibial fractures, sometimes, it is necessary to use more than ten liters of fluid, normal saline and hydrogen. Before washing the wound, swabs should be taken to identify the cause of the contaminated wound, and determine their sensitivity to antibiotics. Primary treatment includes removal of damaged parts of the skin, subcutaneous fat, fascia, muscle and small bone fragments (12). Necrotic muscle tissue is a good substrate for the development of both anaerobic and aerobic microorganisms. During the processing of the muscle tissue, we use the „4C“ rule (color, consistency, capillary bleeding, contractility). During debridement of muscle tissue, if there is no bleeding at the interface, the muscle does not contract when captured with tweezers, has not a nice natural pink color and there is no proper consistency, it should be removed „till reaching a healthy tissue“, because damaged and necrotic muscle represents a good substrate for the growth of microorganisms. Debridement of open tibial fracture wounds can be repeated after twenty-four or forty-eight hours and the goal is the removal of entire necrotic tissue. Adequate primary treatment of open fracture wounds is a very important step in prevention of deep bone infection and rescue of the extremities (4). Primary surgical treatment of open fracture wounds, antibiotic therapy and anti-tetanus vaccine, according to the protocol, is the best prevention of anaerobic infections (gas gangrene and tetanus).

External skeletal fixation is a standard method for the stabilization of open tibial shaft fractures. It provides good conditions for the biomechanical reconstruction of open tibial fractures, and offers good access to early care and does not interfere with the movements of the knee and ankle. The problems encountered in this method are common soft tissue and bone infections around the pins of external skeletal fixator, especially in patients where the device was carried for more than 6 months and a higher percentage of nonunion and fracture healing in a bad position (13, 14).

If there is a lower leg bone defect caused by the strong trauma, bone defect is filled by iliac bone or other body parts. In addition to osteoplasty, sliding-graft method can be also applied. It involves cutting the tibial diaphysis in metafiseal area and lowering the bone in the defect zone (15).

We do not primarily close the wound, but leave it open till the time we are absolutely sure that there are no signs of infection (by delayed primary suture, secondary closure or using some of the methods of plastic reconstructive surgery such as skin grafts, fascio-cutaneous flaps, microvascular tissue transfer, etc). Caudle and Stern point out that early aggressive soft tissue reconstruction in the first seven days after injury to cover the exposed bone in open fractures grade III significantly reduces the risk of infection, nonunion fractures and impending amputation (16). An indication for amputation of limbs in open, lower leg fractures is the damage of the main blood vessels and irreversible injury of vascularization, distal to the site of lesion, which cannot be solved by any method of treatment (reconstructive surgery) (17).

## CONCLUSION

Open fractures of the lower leg represent the most difficult fractures of the lower leg. Because there is communication with the external environment these wounds are primarily contaminated with microorganisms. Primary treatment of open fracture wounds is an important factor in prevention and development of both anaerobic and aerobic infections. After primary treatment of fracture wounds, fractured bone was stabilized by external skeletal fixation and the wound was not closed primarily. It should be closed secondarily, by suture, if possible, or by one of the methods of plastic surgery (skin graft, fascio-cutaneous flap or microvascular tissue transfer). In addition to primary treatment of fracture wounds and extrafocal fixation, it is very important to prescribe adequate antibiotic and anti-tetanus protection in the prevention of aerobic and anaerobic infections. In open tibial fractures with bone defect, the shaft length and axis maintenance of the injured limb is achieved by external fixation, while the defect compensation is achieved at the stage of secondary surgery by spongioplasty or by sliding method. Primary treatment of open fractures wounds, external skeletal fixation, antibiotic and anti-tetanus protection are the basic elements of the rescue and recovery of injured lower leg. The most common complications of this kind of lower leg fractures are: deep bone infection-osteitis, nonunion, pseudoarthrosis and limb amputation. An indication for amputation of limbs in open tibial shaft fractures is a violation of main blood vessels and the absolute irreversible cessation of vascularization, distal to the site of lesion, which cannot be solved by any method of treatment (reconstructive surgery).

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# KONKVASANTNI PRELOM POTKOLENICE NAKON GAŽENJA AUTOBUSOM, LEČEN METODOM SPOLJNE SKELETNE FIKSACIJE. PRIKAZ SLUČAJA

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## Sažetak

**Pacijentkinja stara 72 godine zadobila je otvoreni konkvasantni prelom desne potkolenice gaženjem točkovima autobusa. Odmah je dovezena u KC u Nišu, gde je nakon kliničkog pregleda, zbog težine povrede predložena potkolena amputacija. Po prijemu u Kliniku za ortopediju i traumatologiju, nakon reanimacije, urađena je arteriografija krvnih sudova desne noge. Registrovan je spazam krvnih sudova desne potkolenice ispod mesta preloma, ali sa prisutnom cirkulacijom u distalnom delu potkolenice i stopala. Nakon skidanja privremene imobilizacije i zavoja na potkolenici, registrovana je velika rana koja se pružala od prstiju stopla do zatkolene jame. Urađena je primarna obrada rane, koja se pružala od prstiju stopala do kolenog zgloba. Prelom je stabilizovan spoljnim skeletnim fiksatorom sa konvergentnom orjentacijom klinova. Rana otvorenog konkvasantnog preloma velikim delom je ostavljena otvorena, dok su vitalne strukture potkolenice (magistralni krvni sudovi i nervi) pokriveni mekim tkivima, koja su situacionim šavovima**

**adaptirana. Zbog velikog oštećenja mekih tkiva desne potkolenice prilikom gaženja i dijabetične agiopatije, radi nastavka lečenja, pacijentkinja je upućena u SOHB „Banjica“ u Beogradu koja raspolaže barokomorom. Nakon ponovljenih debridmana rane, spoljni skeletni fiksator je skinut i plasiran aparat po Ilizarovu. Defekt mekih tkiva pokriven je transplantatom po Tirsch-u. U postoperativnom toku bolesnica je redovno previjana. Nakon osam meseci od povređivanja, došlo je do zarastanja preloma i aparat po Ilizarovu je skinut. Bolesnica je upućena na rehabilitaciju. Po završenoj rehablitaciji, bolesnica se vratila svojim radnim i životnim aktivnostima.**

***Ključne reči:*** **konkvasantni prelom potkolenice, primarna obrada rane, spoljna skeletna fiksacija, aparat po Ilizarovu.**