Treatment of Open Tibial Fracture with Bone Defect Caused by High Velocity Missiles: A Case Report

Zoran Golubović[1,2], Zoran Vukašinović[3,4], Predrag Stojiljković[1], Ivan Golubović[1], Aleksandar Višnjić[2], Zoran Radovanović[2], Stevo Najman[2]

[1]Clinic for Orthopaedic Surgery and Traumatology, Clinical Center, Niš, Serbia;
[2]School of Medicine, University of Niš, Niš, Serbia
[3]Institute for Orthopaedic Surgery „Banjica", Belgrade, Serbia;
[4]School of Medicine, University of Belgrade, Belgrade, Serbia

SUMMARY

Introduction Tibia fracture caused by high velocity missiles is mostly comminuted and followed by bone defect which makes their healing process extremely difficult and prone to numerous complications.

Case Outline A 34-year-old male was wounded at close range by a semi-automatic gun missile. He was wounded in the distal area of the left tibia and suffered a massive defect of the bone and soft tissue. After the primary treatment of the wound, the fracture was stabilized with an external fixator type Mitkovic, with convergent orientation of the pins. The wound in the medial region of the tibia was closed with the secondary stitch, whereas the wound in the lateral area was closed with the skin transplant after Thiersch. Due to massive bone defect in the area of the rifle-missile wound six months after injury, a medical team placed a reconstructive external skeletal fixator type Mitkovic and performed corticotomy in the proximal metaphyseal area of the tibia. By the method of bone transport (distractive osteogenesis), the bone defect of the tibia was replaced. After the fracture healing seven months from the secondary surgery, the fixator was removed and the patient was referred to physical therapy.

Conclusion Surgical treatment of wounds, external fixation, performing necessary debridement, adequate antibiotic treatment and soft and bone tissue reconstruction are essential in achieving good results in patients with the open tibial fracture with bone defect caused by high velocity missiles. Reconstruction of bone defect can be successfully treated by reconstructive external fixator Mitkovic.

Keywords: high velocity missiles; tibial fracture; bone defect; reconstructive external fixator Mitkovic

INTRODUCTION

Contemporary weapons have high-initial-velocity and they can cause immense damaging effects on the human body. The severity of wounds and the mortality increase with the development of war technology. The missiles of modern armament cause massive destruction of the anatomy of the wounded body [1, 2]. The rifle-missile fractures of the tibia caused by the contemporary firearms are characterized by massive tissue destruction, primary contamination with polymorphic bacteria and modified body reaction [3]. The severity of the wound depends on the physical characteristics of the missile, its velocity and mass, the biologic characteristics of the wounded tissue, as well as on the kinetic energy transferred upon contact with the tissue [4, 5]. Tibia fractures caused by high velocity missiles are mostly comminuted and followed by bone defect which makes their healing process extremely difficult and prone to numerous complications [6 ,7].

Our objective is to present a patient suffering from severe rifle-missile fracture of the tibia with extensive bone tissue defect primary treated by surgical treatment of the wound and external fixation. The bone defect was treated with secondary surgical intervention (bone transport using reconstructive external fixator Mitkovic). The patient was treated in the Orthopedics and Trauma Clinic of the Medical University of Nis in 1999. Postoperatively the patient was monitored until 2006.

CASE REPORT

A 34-year-old male, a reservist, was wounded accidentally on March 28, 1999, by a semi-automatic gun missile (7.9 mm caliber). The wound was situated in the area of the left shin bone. He suffered a through and through wound in the distal area of the left shin bone with a fragmentary comminuted fracture of the tibia and fibula and the loss of bone tissue. Immediately after the wounding he was transferred to General Hospital in Pristina where he received primary treatment of the wound and external fixation of the fracture. On April 1st, 1999 he was transferred to the Orthopedics and Trauma Clinic of Medical University of Nis.

Upon admittance the patient was conscious, oriented in time, space and towards people. Afebrile, he was complaining of pain in the left shin bone. It was IIIB degree open tibial fracture according to Gustilo classification. Neuro-vascular status of the injured limb was normal. The left tibia was stabilized with an external fixator. Two pins of the external fixator were placed into the tibia diaphysis above the fracture, one pin into the distal tibia fragment

Correspondence to:
Zoran GOLUBOVIĆ
Gutenbergova 37, 18000 Niš
Serbia
golubovicz@bankerinter.net

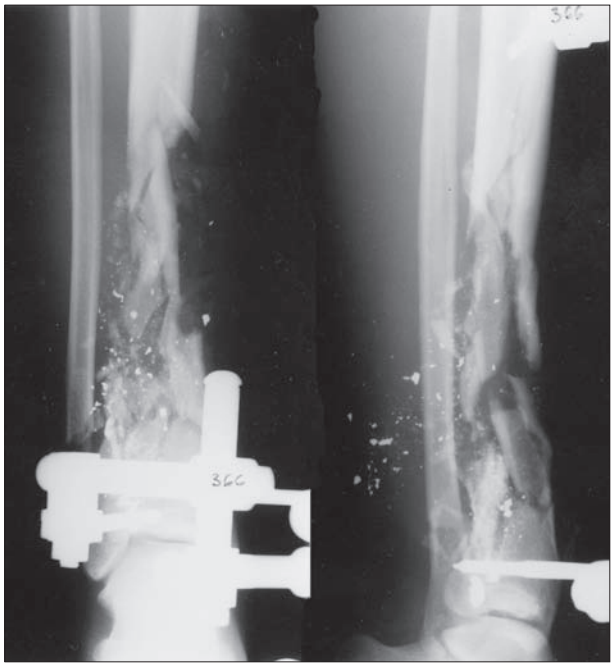

Figure 1. X-rays of the comminuted fracture of the left tibia

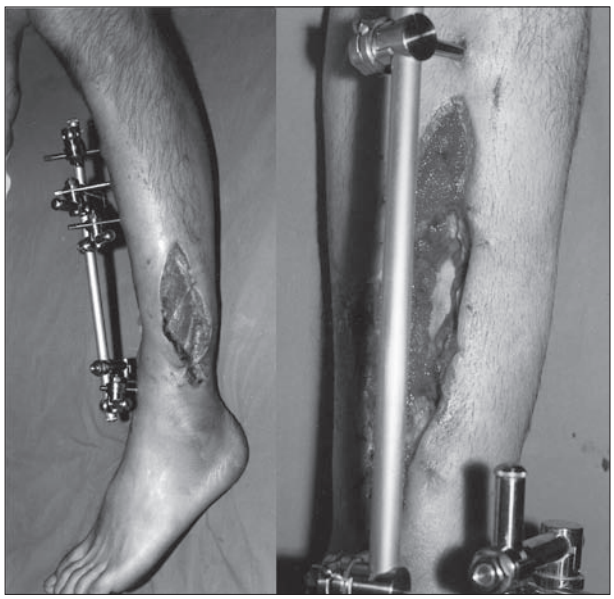

Figure 2. The left lower leg after surgical debridement of wound and fracture stabilization by the external fixator

below the fracture and another pin into calcaneus. The wound on the inner side of the shin bone, 25 cm long and 5 cm wide, was partially sutured with separate stitches.

The X-ray of the left shin bone showed comminuted fracture of the tibia and fibula with extensive loss of bone tissue (Figure 1).

After the complete preoperative preparation the secondary debridement of the wound was performed and the pin from calcaneus was removed in order to enable mobility of the ankle. A new pin was placed into the distal fragment of the tibia below the fracture, just above the ankle (Figure 2). The postoperative procedure included daily bandaging and curettage until clean granulation appears. After the complete preoperative preparation the defect in the outer area was closed with a secondary stitch, whereas the defect

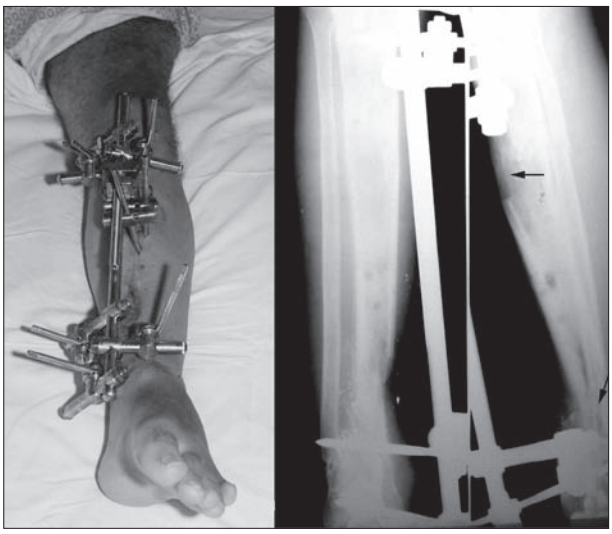

Figure 3. The defect is restored by using the method of distraction osteogenesis with the reconstructive external skeletal fixator type Mitkovic

on the outer area was covered with skin auto-transplant after Tirsch.

After the healing of the wound in the inner area of the shin bone, the patient was discharged and directed to rehabilitation. On September 29th, 1999 the patient was readmitted for the treatment of the remaining bone defect in the distal area of the tibia. The bone defect was about 5 cm due severe multifragmentary fracture comminution.

On October 4th, 1999 under total endotrachial anesthesia, the surgical team performed corticotomy in the proximal, metaphyseal area of the tibia and placed the reconstructive external skeletal fixator type Mitkovic (Figure 3). Postoperative treatment proceeded without complications. The patient was regularly bandaged. Seven days later the distractive osteogenesis is undertaken in the area of the tibia defect.

On October 15th 1999 the patient was discharged from the clinic and advised to continue the distractive osteogenesis (bone transport) – the lowering of the proximal fragment towards the point of defect (1 mm per day). The lowering of the bone in the defect zone of the tibia was continued on a daily basis (1 mm per day) until the bone defect had repaired. The bone transport time was two months. Full weight bearing was allowed after the bone transport was finished.

After the recovery of the fracture seven months after secondary surgery the reconstructive external skeletal fixator was removed and the patient was directed to rehabilitation.

The control examination of the patient was performed six years after the rifle-missile wounding. The patient complained of occasional pain and swelling of the left ankle which appear as a result of standing and walking for a long time. The X-ray of the left shin bone and ankle showed a completely rehabilitated fracture of the tibia in the distal third with metal residue of the missile (Figure 4).

Clinical examination determined a discrete limitation in the movement of the left ankle. There were no neurologic deficiency after finishing treatment.The patient was able to walk on tip-toes and heel bone of the left foot. Both legs

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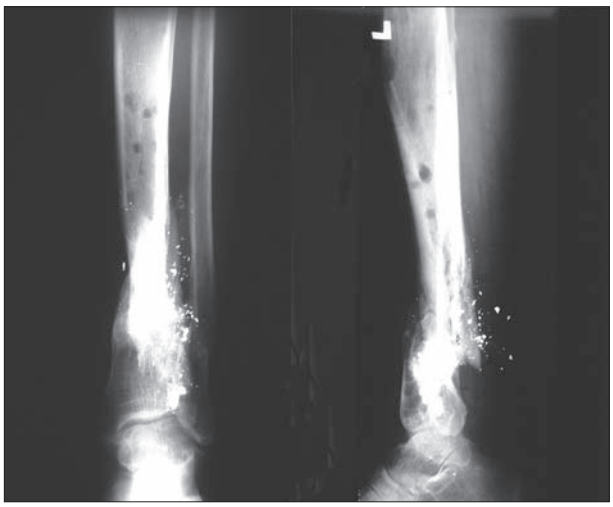

Figure 4. X-rays of the left lower leg 6 years after the injury

Figure 5. Functional outcome after 6 years of injury

were of the same length. The patient could crouch without difficulty (Figure 5).

DISCUSSION

When it comes to the treatment of rifle-missile wounds of the shinbone, the goal of the modern medicine is not only saving the patient's life and limb but also a complete restoration of the functionality of the injured limb. After general check-up and inspection of the injuries, the next step will be reanimation of the patient [8].

Arteriography would be performed if there was a suspicion of the lesion of magisterial blood vessels of the injured shinbone. How fast the lesion is diagnosed is very important for saving the injured limb. A detailed neurological examination is necessary for determining whether the back tibial nerve is damaged. In case there was a lesion of the posterior tibial nerve which could not be heeled, and if there was a disconnection in the arterial circulation for more than six hours and a complete or partial loss of the arterial blood, the primary amputation of the shinbone would be taken into consideration [9].

Early treatment of rifle-missile fracture of the shinbone includes surgical treatment of the wound and external fixation of the fractured bone. The main objectives of the primary surgical treatment are elimination of the devitalized tissue which can harbour bacteria, reduction of the fragment of the fractured bone and the external fixation of the tibia [10].

In order to prevent infections, the primary surgical treatment of the wound should be performed as soon as possible (thorough debridement of the wound, aggressive irrigation) and broad-spectrum antibiotics should be included [11].

Most often we deal with multiple, unstable fractures. External fixation is a method of choice in the treatment of rifle-missile fractures of the shinbone. External fixation with the unilateral external fixator after Mitković, which has a convergent orientation of the nails, provides good stability of the formerly displaced fragments, now reducing them to their normal position. The nails of the external fixator are placed extra-focally, so that there are no foreign bodies in the focal points of the fracture. Unilateral external fixator, unlike bilateral, provides good stability in the fracture zone, it is less damaging, and there is less possibility to harm neurovascular elements upon placing the pins. Unlike cast immobilization, the external fixation provides comfort to a patient and improves the control and postoperative nursing of the wound [8, 12].

We should tend to provide conditions for the reconstruction of the soft tissue within 5 to 7 days or even earlier. Nowadays, it is considered that all reconstructive operations of the soft tissue and the bones should be done within 7 and 21 days, respectively. If the wound did not show the signs of infection, it would be closed with direct suture, Thiersch transplant or flap depending on its size. Muscle flaps or musculocutaneous flaps are most commonly used in the reconstruction of the shinbone soft tissue defect (latissimus free flap) [13].

Antitetanus protection and antibiotics are prescribed to a patient with the rifle-missile fracture of the shinbone A strong systematic antibiotic treatment is necessary for all rifle-missile fractures caused by high-initial-velocity missiles [8].

If the defect of the bone tissue was caused by a strong kinetic force, the defect would be restored by osteoplasty from the ilium crista or other parts of the body. Nowadays, other than osteoplasty, the method of distraction osteogenesis (bone transport) is used, which implies cutting of the tibial diaphysis in metaphyseal area and the lowering of the bone in the zone of defect. For this technique, the apparatus after Ilizarov or the combination of the intramedullary nail and skeletal fixator are most commonly applied [14, 15, 16].

Hutson et al. [17] treated 19 fractures with bone defects (Gustilo grade III B-C open tibia shaft fractures with wide spectrum of injury to the bone and soft tissues) using the protocol of the initial multiple debridement procedures, half pin resuscitation external fixation, soft tissue reconstruction over antibiotic spacers and delayed Ilizarov reconstruction after stabilization of the soft tissue envelope. Mean tibial bone defect was 9.4 cm (5–17 cm). Reconstruction time was 26.5 months (12–73 months). Eighteen

of 19 fractures were reconstructed with the union and no deep infection or osteomyelitis.

The advantages of reconstructive external fixator Mitkovic in bone transport are: simple application, good stability of bone fragments during lowering, convergent pins application provides excellent biomechanical conditions after lowering of fragment for consolidation of bone regenerate and fracture healing.

Due to the simplicity of the device, it is possible to continue the process of bone transport (which usually lasts several months depending on the length of the defect) at home, with bandaging and control once a week at the clinic.

A good preoperative planning in the reconstruction of bone defects is necessary. Any virtual human osteoarticular system would greatly assist in planning of these operations.

Considering the treatment of open tibial fracture with the bone defect caused by high velocity missiles, many authors believe that the external skeletal fixation, early soft and bone tissue reconstruction, systematic antibiotic therapy, intensive rehabilitation and education of the patient are basic principles of fracture healing. Reconstruction of bone defect can be successfully treated by reconstructive external fixator Mitkovic.

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Лечење отвореног прелома голењаче с оштећењем кости насталог рањавањем пројектилом велике почетне брзине – приказ болесника

Зоран Голубовић[1,2], Зоран Вукашиновић[3,4], Предраг Стојиљковић[1], Иван Голубовић[1], Александар Вишњић[2], Зоран Радовановић[2], Стево Најман[2]

[1]Клиника за ортопедију и трауматологију, Клинички центар, Ниш, Србија;
[2]Медицински факултет, Универзитет у Нишу, Ниш, Србија;
[3]Институт за ортопедску хирургију „Бањица“, Београд, Србија;
[4]Медицински факултет, Универзитет у Београду, Београд, Србија

КРАТАК САДРЖАЈ

Увод Преломи тибије изазвани пројектилима велике почетне брзине су најчешће коминутивни и уз оштећење кости, што њихово зарастање чини веома тешким, а сам процес лечења праћен честим компликацијама.

Приказ болесника Мушкарац стар 34 године рањен је из близине пројектилом из полуаутоматске пушке. Повређена му је лева дистална потколеница с великим оштећењем мекоткивног омотача и кости. Повреда је примарно лечена примарном обрадом ране и спољашњом скелетном фиксацијом прелома једностраним спољашњим фиксатором по Митковићу са конвергентном оријентацијом клинова. Мекоткивни дефект с медијалне стране затворен је секундарним шавовима, а с латералне стране слободним кожним трансплантатима по Тиршу. Због опсежног оштећења кости, шест месеци након рањавања оперисан је на нашој клиници, када је урађена кортикотомија тибије у метафизном делу и постављен реконструктивни спољашњи фиксатор по Митковићу ради реконструкције коштаног дефекта коштаним транспортом. По зарастању прелома и консолидације регенерата, реконструктивни спољашњи фиксатор је скинут после седам месеци, а болесник је упућен на рехабилитацију.

Закључак Хируршка обрада ране, спољашња скелетна фиксација, антибиотска терапија и реконструкција мекоткивног и коштаног дефекта су основни елементи у лечењу отворених прелома тибије насталих рањавањем пројектилима велике почетне брзине. Реконструкција оштећене кости може се успешно обавити применом спољашњег фиксатора по Митковићу.

Кључне речи: пројектил велике почетне брзине; прелом тибије; коштани дефект; реконструктивни спољашњи фиксатор по Митковићу

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