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Case report ■

Correction of Secondary Dislocation of Open Tibial Shaft Fracture after External Fixation-Case Report

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SUMMARY

Open tibial shaft fractures rank as the most common fractures of the locomotor system. External skeletal fixation, after primary open fracture wound management, stands for a good method in the management of open tibial shaft fractures, as it does not poses an additional threat to the bone vascularisation in the fracture area, which is important for wound healing and reduction of deep infection occurrence percentage. The paper presents a nineteen-year-old patient who sustained an open right tibial shaft fracture in a motorcycle accident when he ran into a car. After performing an x-ray examination and short preoperative preparation, we proceeded to primary open fracture wound management, bloody reposition of tibial fragments and external fixation by unilateral external skeletal fixator with convergent pin orientation. Early postoperative course was uneventful. Twenty days following the external fixation, the patient fell while getting out of the car, when his crutch stuck in the metal fence. On control x-ray examination, a dislocation of tibial fragments was seen at the fracture site. After the administration of appropriate analgesic therapy and loosening the external fixator clamps, a correction of fracture dislocation was performed. On control x-ray examination, a good position of fragments after correction was observed. The unilateral external skeletal fixator "Mitković" produced by "Trafix" firm enables a simple correction of fracture dislocation, without performing additional surgical procedures.

Key words: **external skeletal fixator "Mitković", reduction of dislocation, open tibial shaft fracture**

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INTRODUCTION

Due to its exposure in the human locomotor system, the shin is most commonly subjected to injuries and open tibial shaft fractures rank as the most common open fractures (1). These fractures are the most frequent open fractures of the long bones. According to data from literature, tibial shaft fractures account for 40% of all diapheaseal fractures treated in orthopedic institutions (2). They occur due to the impact of direct or indirect high-energy trauma. Because of its position in the locomotor system, the shin is frequently subjected to injuries both in traffic accidents and everyday situations (3). The open as well as many closed tibial shaft fractures may pose a serious therapeutic problem. In the management of tibial fractures, various operative and non-operative methods are utilized. Operative treatment involves the application of the external and internal fixation - intramedullary or compression plate fixation (4, 5). External skeletal fixation is a method of choice in the management of open tibial shaft fractures (6). Due to its subcutaneous localization, the tibia is very convenient for the application of external skeletal fixator (7). Destruction of skin and other soft tissues, marked comminution or loss of the bone tissue and infection make the management of open tibial shaft fractures very complicated (1, 8). The basic aim of the management is to avoid primary amputation and to reestablish a full function of the injured limb. Making the right choice in respect to management is the most important moment in the management process. Success in the management of tibial shaft fractures depends on severity of injury, patient's overall condition, associated fractures and injuries, as well as the applied treatment method (9, 10).

The aim of the paper was to present the patient with an open tibial shaft fracture, in whom, after the operative treatment and external skeletal fixation application, dislocation occurred after a fall. Secondary dislocation was resolved by loosening the external fixator clamps and repeated fracture reposition, without opening the fracture focal point. In addition, the aim was to demonstrate, by using the bone model, the technique of fracture reposition without opening the fracture focal point.

CASE REPORT

The patient, nineteen years old, sustained an open right tibial shaft fracture in a motorcycle accident when he collided with a car. Immediately after the immobilization he was referred to the Orthopedics and Traumatology Clinic, Clinical Center Niš, where he was hospitalized the same day. After the x-ray examination of the fracture, preoperative preparation was initiated (Figure 1). Following the short preoperative treatment, primary open fracture wound management was done, as well as bloody reposition of tibial fragments and external skeletal fixation by unilateral external skeletal fixator with convergent pin orientation (Figure 2). Early postoperative treatment was uneventful. The patient began to use the axillary crutches, with the partial weight bearing on the operated leg. The patient was released from hospital and advised to continue with treatment at home. Twenty days following the external fixation, the patient fell while getting out of the car when his crutch stuck in the metal fence. On control x-ray examination, a dislocation of tibial fragments was seen at the fracture site (Figure 3). After the administration of appropriate analgesic therapy and loosening the external fixator clamps, a correction of fracture dislocation was undertaken (Figure 4). On control x-ray examination, a good position of fragments after correction was observed. The unilateral external skeletal fixator "Mitković" produced by "Trafix" firm enables a simple correction of fracture dislocation, without additional surgical procedures required. Correction of valgus and varus is performed by loosening the clamp which holds the distal pin placed in the medio-lateral direction (Figure 5). Correction of antecurvatum and recurvatum is undertaken by loosening the clamp which holds the pin placed in anteroposterior direction (Figure 6).

The treatment was continued by regular bandaging around the external skeletal fixator pins every seven days and progressive increase in the amount of weight placed on the operated leg. After four months, the fracture united with marked periosteal callus formation; the external skeletal fixator was removed (Figure 7).

The patient has a stable weight-bearing on the operated leg and a satisfactory range of motion in the right ankle joint (Figure 8).

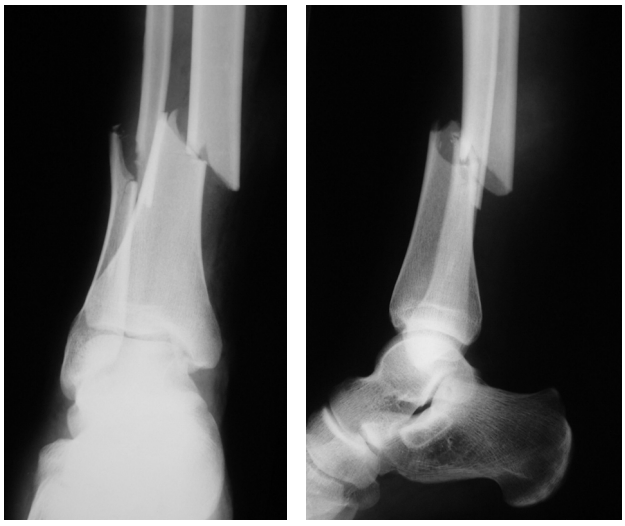

Figure 1*. X-ray of open right tibial shaft fracture in AP and LL projections*

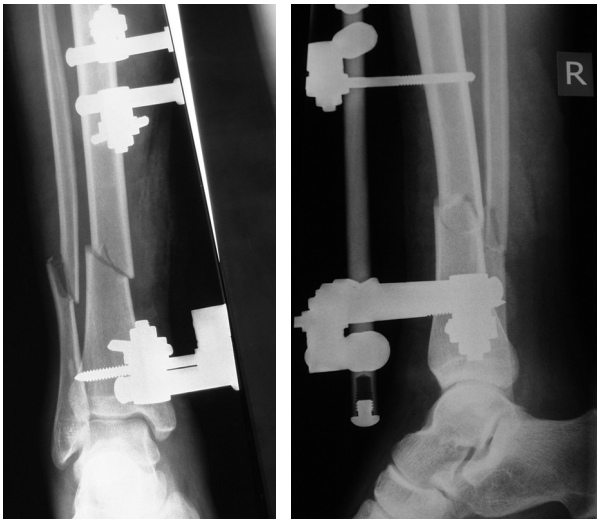

Figure 2. *X-ray of open right tibial shaft fracture in AP and LL projections after open reposition and fracture fixation by external skeletal fixator*

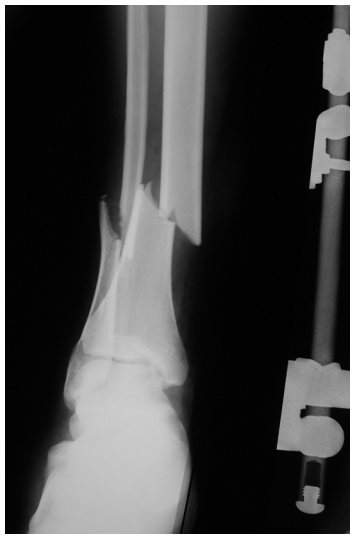

Figure 3. *X-ray of open right tibial shaft fracture in AP and LL projections after fall of a patient and secondary fracture dislocation*

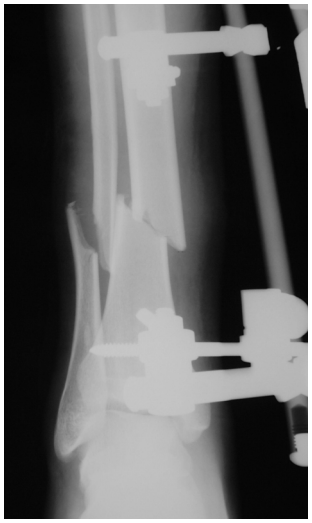

Figure 4. *X-ray of open right tibial shaft fracture in AP and LL projections after correction of secondary fracture dislocation*

Figure 5. *Corrections of varus and vagus by external skeletal fixator on a bone model*

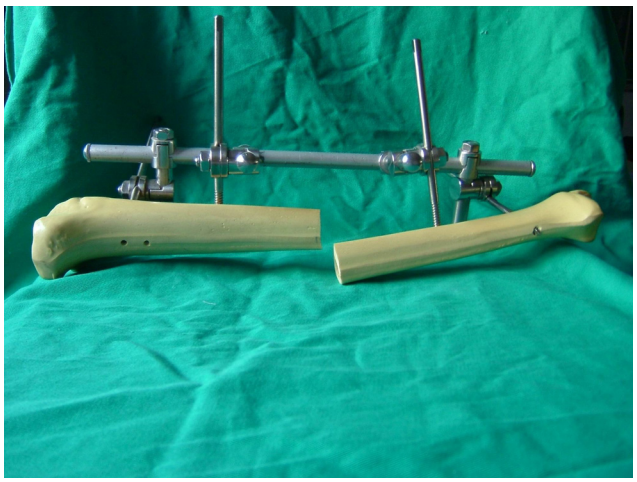

Figure 6. *Corrections of antecurvatum and recurvatum by external fixator on a bone model*

Figure 7. *X-ray of open right tibial shaft fracture in AP and LL projections after removal of external skeletal fixator*

Figure 8. *Presentation of a patient after completed treatment of open tibial shaft fracture. Patient has stable weight-bearing on the injured lag after completed treatment*

DISCUSSION

According to the mechanisms of injury, the open tibial shaft fractures occur due to the impact of direct or indirect high-energy trauma, usually in motor vehicle accidents, industrial accidents or while working in the field. In indirect mechanisms of injury, the open tibial shaft fractures occur when bone fragments penetrate through the skin and soft tissues. This is typical of spiral tibial fractures reported in skiers, after falls, and in other sports activities. Injuries caused by indirect violence are usually of lesser intensity compared to injuries caused by direct trauma (11). There are several classifications of open fractures (Gustillo, Miller, Anderson, Bird). However, the most commonly applied is the classification given by Gustillo, which is based on the amount of energy causing a fracture and extent of the soft-tissue injury (12, 13). Due to communication of the fracture focal point and bone fragments on the one hand and environment on the other, open fractures are regarded as primary contaminated. Whether the bone infection will develop or not depends on the degree of contamination, virulence of microorganisms, patient's immunity, damage of bone and soft tissues' vascularisation and primary surgical treatment of the open fracture wound. Open tibial shaft fractures require urgent surgical treatment, when the patient's condition allows (14). The rule of "six hours" which points that infection can be attenuated if surgical treatment is performed in the first six hours was confirmed by the studies conducted in 1995 by Kindsfater and Jonassen (15) and Kreder and Armstrong (16). Primary treatment of the open fracture wound is a very important factor for the prevention of osteitis, gas gangrene and tetanus (11). Before wound debridement of the open tibial shaft fracture, it is necessary to profusely rinse the wound (using the saline solution, hydrogen and povidone-iodine solution) and mechanically remove all foreign material from the wound - soil, pieces of clothes and footwear. Sometimes, it is necessary to use more than ten liters of liquids to rinse the open tibial shaft fracture wound. Before wound rinsing, it is necessary to take a wound swab to identify the causes of wound contamination, but also to determine their resistance to antibiotics. Primary wound treatment includes debridement, i.e. removal of damaged parts of the skin, subcutaneous fatty tissue, fascia, muscles and small deperiosted bone fragments. The necrotic muscle tissue is a good media for the development of both aerobic and anaerobic microorganisms. During muscle tissue treatment, we pay attention to color, consistence, bleeding and contractility. If, during the treatment, the muscle tissue does not bleed on the cross-section, does not contact when grasped with tweezers, has no natural pink hue and adequate consistence, then it should be removed until healthy tissue is reached, as it supports significant bacterial growth. Debridement of the open fracture wound can be repeated after 24 hours i.e. 48 hours with the aim to remove the necrotic tissues which had become demarcated (secondary and tercial debridements of the open fracture wound) (11). An adequate preparation of the open fracture wound is a very important step in the prevention of deep bone infection and saving the extremities (17).

Early intravenous antibiotic therapy in the open femoral shaft fractures decreases the percentage of infections' complications (osteitis and infection of soft tissues) and should be initiated right after the admission of the patient (18). Cefazolin, which covers all gram-positive bacterial flora, should be administered for all open fractures. Aminoglycosides which cover the aerobic gram-negative bacilli are indispensable for the treatment of open fractures with extensive soft-tissue injuries and massive contamination. Penicillin is active against the anaerobes and should be prescribed when there is a possibility of the wound contamination by anaerobes (Clostridium perfigensom and Clostrium tetani), which is common in agricultural work-related injuries, when the wound is contaminated with soil. Benzylpenicillin is given in the dose up to 10.000.000 i.u. through the intravenous infusion every six hours. The antibiotic therapy is continued the next 48-76 hours in cases of types I and II open fractures, while in type III open fractures the therapy can be prolonged up to 120 hours after open fracture and primary wound debridements (11). In patients with open tibial shaft fractures, the antitenaus protection is given according to the protocol depending on the patient's immune status.

External skeletal fixation is a standard method of stabilization of all open tibial shaft fractures except type I fracture (19). External skeletal fixation provides good biomechanical conditions for the management of open tibial shaft fractures, enables good approach and wound management, and does not disturb the movements in

the ankle. The problems encountered when applying this method are common soft tissue and bone infections - pin site infections, especially if wearing the external fixator is longer than six months, then higher percentage of nonunions and malunions (20, 21).

Unilateral external fixator "Mitković" enables early and late corrections of axial deformities due to the secondary dislocation of bone fragments (7).

The existence of a virtual osteoarticular system would vastly help in everyday clinical practice and planning of corrections of tibial shaft axial deformities. We do not primarily close the operative wound treatment, but let it open until we are completely sure that there are no more signs of infection, and then close it by secondary suture or by using some of the plastic surgery methods, depending on the severity of the soft tissue defect (fasciocutaneous flaps, microvascular transplants, etc). Modern orthopedic surgery advocates that wounds should be closed as early as possible, but with the appropriate primary wound debridement (22). Caudle and Stern emphasize that early aggressive soft tissue reconstruction, performed in the first seven days after sustaining an injury, with the aim to achieve the exposed bone coverage in type III open fractures, significantly reduces the risk of infections, nonunions and the consequential amputation (23).

CONCLUSION

Open tibial shaft fractures rank as the most common fractures of the locomotor system. After primary wound management, the fracture is stabilized by the application of the external fixator. The open fracture wound is closed by a secondary suture or using some of the plastic surgery methods (fasciocutaneous flap ir microvascular flap). Besides primary wound management and extrafocal fixation of the open tibial shaft fracture, it is important to provide adequate antibiotic and antitetanus protection. External skeletal fixation, after the primary open fracture wound management, is a good method of choice in the management of open tibial shaft fractures, as it does not additionally jeopardize the bone vascularization in the fracture area, which is very important for fracture healing. Extrafocal stabilization of the open fracture reduces the risk of deep bone infection - osteitis, which is one of the most severe complications after sustaining the open tibial shaft fracture. In case of a secondary fracture dislocation, the external fixator "Mitković" with convergent pin orientation provides a simple correction of a dislocation, without opening the fracture site in the outpatient setting.

Acknowledgement

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KOREKCIJA SEKUNDARNE DISLOKACIJE OTVORENOG PRELOMA POTKOLENICE NAKON SPOLJNE SKELETNE FIKSACIJE - PRIKAZ SLUČAJA

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Sažetak

Otvoreni prelomi potkolenice spadaju u grupu najčešćih otvorenih preloma lokomotornog sistema. Spoljne skeletne fiksacije, nakon primarne obrade rane otvorenog preloma, predstavljaju dobru metodu u lečenju otvorenih preloma potkolenice, jer dodatno ne ugrožavaju vaskularizaciju kosti u zoni preloma, što je važno za zarastanje preloma i smanjuje procenat duboke infekcije. U radu se prikazuje bolesnik star 19 godina, koji je zadobio otvoreni prelom desne potkolenice u saobraćajnoj nesreći, kada je skuterom udario u automobil. Nakon rendgenske dijagnostike preloma i kratke preoperativne pripreme urađena je primarna obrada rane otvorenog preloma, krvava repozicija fragmenta tibije i spoljna skeletna fiksacija, unilateralnim spoljnim skeletnim fiksatorom sa konvergentnom orjentacijom klinova. Rani postoperativni tok protekao je uredno. Dvadeset dana nakon spoljne skeletne fiksacije bolesnik je prilikom izlaska iz automobila zakačio štake u metalnu ogradu i pao. Na kontrolnom rendgenskom snimku registrovana je dislokacija fragmenta tibije na mestu preloma. Uz analgetsku terapiju u bolesničkoj sobi, nakon otpuštanja klema spoljnog skeletnog fiksatora, urađena je korekcija dislokacije preloma. Na kontrolnom rendgenskom snimku registrovan je dobar položaj fragmenta nakon korekcije.

Unilateralni spoljni skeletni fiksator sa konvergentnom orjentacijom klinova „Mitković“, firme „Trafix“, omogućuje jednostavnu korekciju dislokacije preloma bez dodatnih hirurških zahvata.

Ključne reči: **spoljni skeletni fiksator Mitković, korekcija deformacije, otvoreni prelomi potkolenice**