Infection after open fracture of the tibia in polytraumatized patient

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Summary: Open fractures of the shinbone are the most common open fractures of long bones, typically resulting from direct or indirect exposure to strong force. Open fractures of the shinbone are often encountered in the context of polytrauma. This case presents a 58-year-old patient who experienced polytrauma after falling from a crane at a height of approximately four meters, resulting in an open fracture of the shinbone classified as Gustilo grade III B and a head injury. Upon admission to the hospital, diagnostic and preoperative preparations were carried out. The patient underwent a surgical procedure, during which the open fracture of the shinbone was stabilized with an external skeletal fixator, and the wound was closed with primary sutures. Due to the head injury, the patient was transferred to the neurosurgery clinic. During postoperative treatment, the patient developed a high fever, prompting a consultation with the orthopedic specialist. Upon removal of the dressing and gauze, purulent secretion was observed between the primary sutures of the wound. Following suture removal, soil was found in the depth of the wound along with purulent secretion. The wound was thoroughly irrigated, and foreign material, including the soil, was removed. The wound was left open, and antibiotic therapy was prescribed (amp. Ceftriakson a 2,0 gr/24 h, amp. Amikacin a 1,0/gr, Metronidazol a 500mg/8h). The patient underwent daily dressing changes, leading to improvement. The wound healed by secondary intention. After the fracture healed and completion of physical therapy, the patient returned to their work and daily activities.

Key words: open fracture, lower leg, bleeding, extremity

INTRODUCTION

Open fractures of the shinbone occur as a result of direct or indirect force and belong to the most severe fractures of the musculoskeletal system. In open fractures of the shinbone, damage to surrounding soft tissues creates highly unfavorable biological conditions for fracture healing. Due to the impairment of both intramedullary and periosteal vascularization, open fractures of the shinbone are predisposed to delayed healing and the development of pseudoarthrosis, with a constant risk of infection and osteitis [1].

The treatment of open fractures of the shinbone is challenging due to the extent of the injury. External skeletal fixation is commonly employed in the treatment of open fractures today. When using external skeletal fixation for the treatment of open fractures, good stability is achieved with minimal additional damage to the soft tissue envelope of the shinbone. The pins of the external skeletal fixator are placed away from the fracture site, minimizing additional damage to the intramedullary and periosteal vascularization of the bone in the fracture zone, which is crucial for fracture healing [2].

The treatment of open fractures of the shinbone involves removing all foreign bodies from the open fracture wound, thorough irrigation of the wound with saline and hydrogen peroxide, debridement of damaged tissues, fracture stabilization, and delayed closure of the open fracture wound

Open fractures of the shinbone occur as a result of direct or indirect force and are among the most severe fractures of the locomotor system. In open fractures of the shinbone, there is damage to surrounding soft tissues, creating very unfavorable biological conditions for fracture healing. Due to damage to both intramedullary and periosteal vascularization, open fractures of the shinbone are predisposed to slow healing and the development of pseudoarthrosis, with a constant threat of infection and osteitis [1]. Treating open fractures of the shinbone is accompanied by significant difficulties due to the extent of the injury. External skeletal fixation is now used in the treatment of open fractures. When applying external skeletal fixation in the treatment of open fractures, good stability is achieved with

minimal additional damage to the soft tissue envelope of the shinbone. The pins of the external skeletal fixator are placed away from the fracture site to avoid further damage to intramedullary and periosteal vascularization in the fracture zone, which is crucial for fracture healing [2]. Treatment of open fractures of the shinbone involves removing all foreign bodies from the wound, thorough irrigation of the wound with physiological solution and hydrogen peroxide, debridement of damaged tissues, fracture stabilization, and delayed closure of the open fracture wound.

OBJECTIVE OF THE STUDY

The aim of our study is to present the treatment of a polytraumatized patient with an open fracture of the shinbone using external skeletal fixation with the Mitković unilateral external fixator. The treatment goal is to avoid primary amputation and to restore full function of the injured limb..

MATERIAL AND METHOD OF WORK

The study depicts a polytraumatized patient with an open fracture of the shinbone, who underwent primary wound management followed by external skeletal fixation, and closure of the open fracture wound with primary sutures. However, during the subsequent course of treatment, the patient developed severe infection and sepsis.

CASE REPORT

A 58-year-old patient sustained an open fracture of the shinbone by falling from a height of approximately 4 meters, landing on stacked logs.

Upon admission to the hospital, the patient was prepared for surgical intervention, and a reduction and external skeletal fixation of the shinbone were performed. The open fracture wound of the shinbone was primarily sutured (see images 1 and 2).

Fig. 1 and 2. X-ray images of the open fracture of the shinbone after the realignment of bone fragments and stabilization of the fracture with an external skeletal fixator.

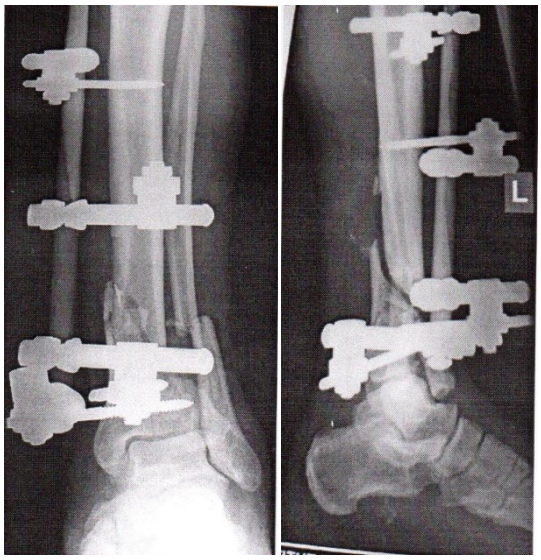
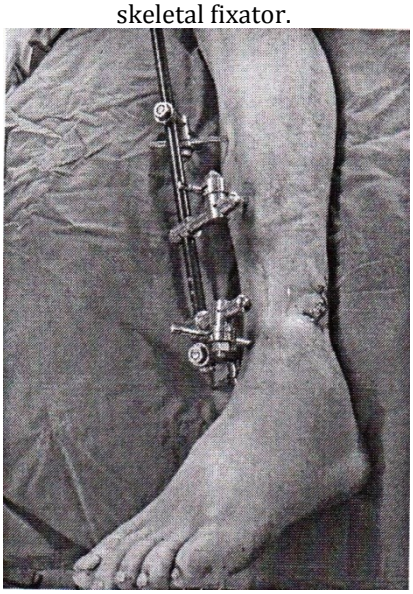


Fig. 3. Condition after stabilization of the open fracture of the distal third of the shinbone using an external skeletal fixator.



Due to a head injury, the patient was hospitalized in the neurosurgery clinic. During the treatment, the patient developed high fever. A follow-up examination was conducted, during which the primary sutured wound of the open fracture of the shinbone was observed, with inflammation and purulent discharge between the wound sutures.

Fig. 4. The wound of the open fracture of the shinbone is inflamed, and there is purulent discharge present between the wound sutures.

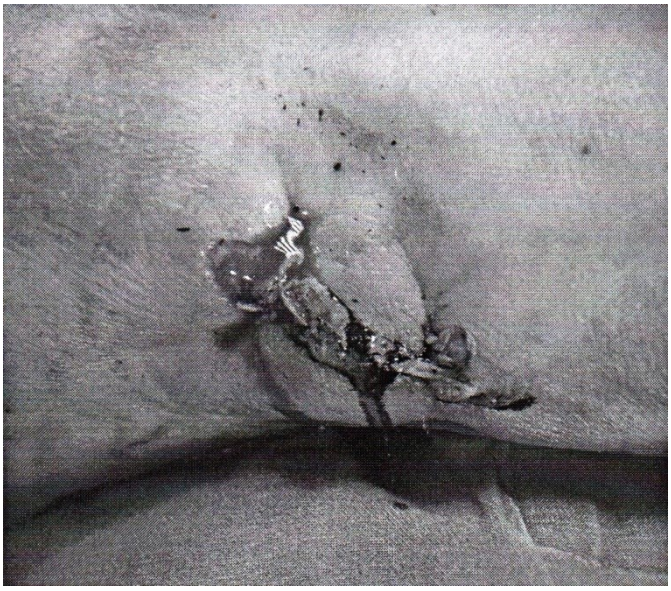
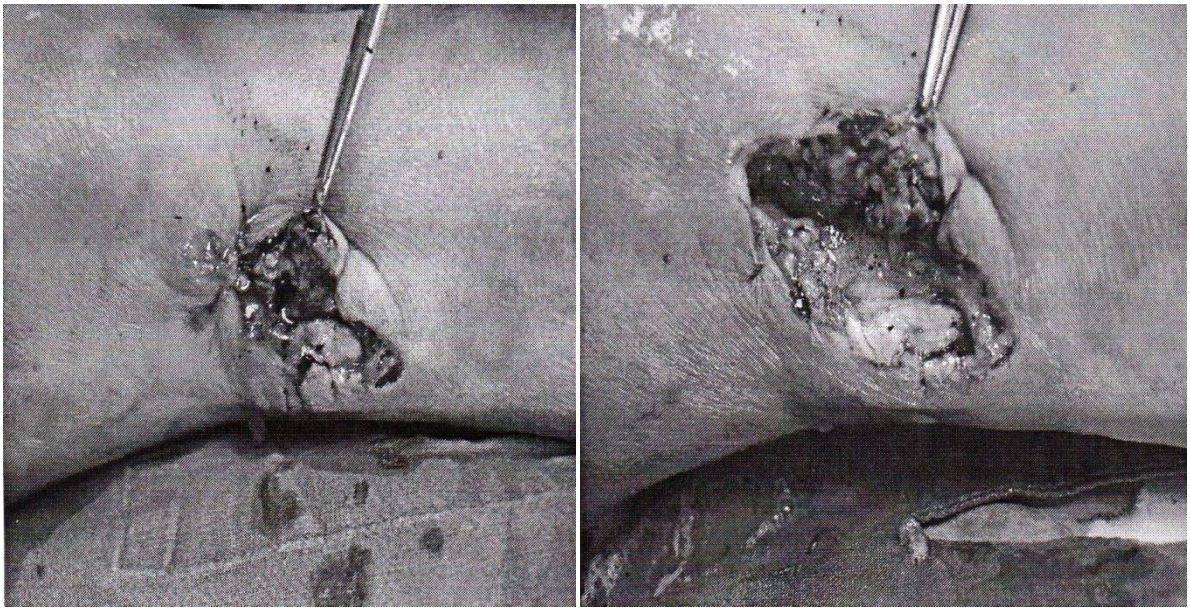
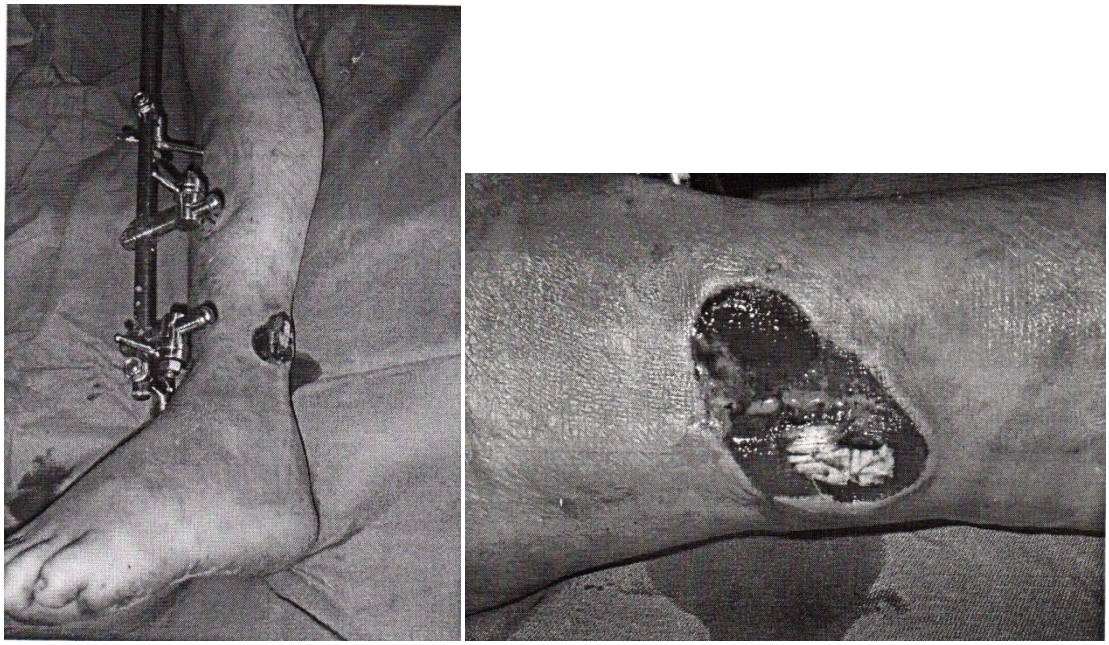


Fig. 5 and 6. The sutures used to close the open fracture wound initially were removed from the wound, and foreign material, soil, and pus were found within the wound..



The wound was thoroughly irrigated, and wound debridement was performed layer by layer for the open fracture of the shinbone. Foreign material was removed, and the wound was extensively irrigated again. Following the debridement of the open fracture wound, the wound was not sutured but left open (see images 7 and 8).

Fig. 7 and 8. The condition of the wound after debridement and thorough irrigation. Following debridement, the open fracture wound was left open.



The patient was prescribed antibiotic therapy (amp. Ceftriakson 2g/24h, amp. Amikacin 1g/24h, and Metronidazol 500mg/8h). Following the wound debridement and antibiotic therapy, the temperature

normalized, and the wound healed. After the fracture healed and physical therapy, the patient returned to their work and daily activities.

DISCUSSION

Open fractures of the shinbone are the most common open fractures of long bones. They occur as a result of direct or indirect force. Direct mechanisms of injuring the shinbone typically occur in traffic accidents, during agricultural work, falls from great heights, gunshot wounds to the shin region, and so forth. Indirect mechanisms of injury lead to the majority of shinbone fractures during sports activities such as skiing, falls, or other sports-related activities. Damage to the soft tissues of the shinbone usually occurs due to high-intensity force or displacement of sharp bone fragments that penetrate the soft tissues from within. In open fractures, there is communication between the fracture site and the external environment. Open fractures are primarily contaminated with microorganisms from the external environment.

In the clinical presentation of an open fracture of the shinbone, there is communication of the fracture site with the external environment, pain, deformity, bleeding, hematoma, local swelling, pathological mobility, and loss of function of the injured limb. Due to the potential injury to major blood vessels, it is necessary to check pulses such as the dorsalis pedis artery, anterior tibial artery, and posterior tibial artery. Radiological diagnostics (conventional X-rays, MSCT, magnetic resonance imaging) are the most significant and precise methods to gain insight into the shape of the shinbone fracture, the degree of displacement, and the location of the fracture. X-ray imaging of the diaphysis of the injured shinbone in two directions with the knee and ankle joints should be conducted to avoid missing associated fractures at the joint levels.

Upon admission of the patient with an open fracture of the shinbone, a clinical examination and X-ray diagnostics should be performed if the patient's condition allows or after resuscitation. Inspect the open fracture wound and take a wound swab for culture and antibiotic susceptibility testing. In the operating room, irrigate the wound with physiological saline and hydrogen peroxide (sometimes it may be necessary to use up to ten liters of fluid for wound irrigation), and remove all visible foreign bodies from the wound. After that, prepare the surgical field in the standard manner. One of the most important procedures in combating infection in open fractures is the primary surgical wound management (debridement, removal of damaged and devitalized tissues), which provide a good substrate for the development of bone infection, osteomyelitis, or specific infections such as gas gangrene and tetanus. Debridement is performed from the surface to the deeper layers of the wound. Firstly, debride the skin. The skin is resistant to trauma, and caution should be exercised during debridement to avoid creating a large defect unnecessarily. Only remove damaged and avascular parts of the skin. Skin vitality is assessed based on capillary bleeding. Skin that bleeds upon incision is vital and should not be removed. Subcutaneous fat tissue is poorly vascularized and avascular parts should be removed. Damaged fascia is also removed. If necessary to facilitate repositioning and irrigation of the wound, the fascial opening can be extended longitudinally proximally and distally with a longitudinal incision [5]. It is crucial to perform meticulous (good) debridement of muscle tissue. During muscle debridement, we use the 4K rule (color, consistency, bleeding, contractility). Muscle that does not have a nice pink color is likely avascular, necrotic. Crushed muscle that tears when grasped with forceps is likely avascular. Muscle that does not bleed when incised and does not contract when grasped with forceps or touched with diathermy is likely avascular. During muscle debridement, small portions of muscle with a diameter of about 1cm are removed piece by piece to avoid creating a large defect in vital tissue indiscriminately. It is necessary to remove all avascular, necrotic tissues. If we are unsure about the tissue's vitality, debridement can be repeated after 24 hours or 48 hours when avascular, necrotic tissues will demarcate (primary, secondary, tertiary, etc., debridement). Debridement should be repeated until all avascular, necrotic tissues are removed from the wound. After debridement of the open fracture wound, it should be irrigated again [6].

After the realignment of fractured fragments of the shinbone, the fracture is stabilized with an external skeletal fixator or an Ilizarov apparatus. Vital structures such as major blood vessels, nerves, and bone tissue are covered with vital muscle tissue if possible. Other structures such as fascia, skin, and subcutaneous tissue are not closed. The wound of the open fracture is not primarily closed but managed with methods such as delayed primary closure, secondary closure, skin grafting, fasciocutaneous flap, or another method, once it is ensured that there is no wound infection [7,8].

Antibiotic therapy is initiated immediately after wound swab collection but before the surgical procedure. It is crucial that antibiotic therapy is administered to the patient as soon as possible. A cephalosporin and an aminoglycoside antibiotic are prescribed (Ceftriakson 2g/24h, Amikacin 1.0g/24h) to cover both gram-positive and gram-negative flora. If the open fracture is contaminated with agricultural soil, metronidazole 500mg/8h is also prescribed to prevent gas gangrene. Tetanus prophylaxis is administered according to the standard protocol [8,10]. Good debridement is the best prevention against infection, gas gangrene, and tetanus.

Complications in the treatment of open fractures of the shinbone include infection of the open fracture wound, infection around the pins or wires of the external skeletal fixator, deep bone infection (osteomyelitis), gas gangrene, tetanus, delayed healing, healing in poor position, nonunion, limb amputation, etc. [11].

CONCLUSION

Treatment of open fractures of the shinbone includes removing all foreign bodies from the wound, thorough irrigation of the open fracture wound with saline and hydrogen peroxide, debridement of damaged tissues until there is no avascular necrotic tissue remaining in the wound, stabilization of the fracture with an external skeletal fixator, antibiotic therapy, and tetanus prophylaxis. The wound of the open fracture is closed when it is ensured that there are no signs of infection, either with delayed primary closure or secondary closure, using skin grafts, fasciocutaneous flaps, microvascular flaps, etc.

Complications in the treatment of open fractures of the shinbone include delayed healing, infection of the open fracture wound, infection around the pins of the external skeletal fixator, osteomyelitis, nonunion (septic or aseptic), limb amputation, and so on.

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