

The journal has had 5 points in Ministry of Science and Higher Education parametric evaluation. § 8.2) and § 12.1.2) 22.02.2019.
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The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 10.10.2021. Revised: 22.10.2021. Accepted: 30.11.2021.

ANALYSIS OF ERRORS AND PREVENTION OF COMPLICATIONS AFTER PEROSSEOUS OSTEOSYNTHESIS

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Abstract

Distal fractures rank a special place among all fractures of the long tubular bones of the extremities. Complications are an inevitable companion of any surgical intervention, as well as an integral part of the work of every surgeon. **Objective:** To analyze the outcomes of treatment of distal fractures of the long bones of the extremities, to identify the causes of errors and the frequency of complications after perosseous osteosynthesis, and to outline ways for their prevention. **Patients and methods:** 1723 patients with distal fractures of the long bones of the extremities and further perosseous osteosynthesis have been under study. Distal fractures of the humerus were registered in 647 patients, those of the femur – in 392, and the bones of the lower leg were damaged in 684. **Results:** The most common complication of perosseous osteosynthesis is inflammation of the soft tissues near the pins - 21.8%. Non-infectious complications (secondary displacement of fragments, contractures, impaired innervation and trophism) were observed in 18.2% of cases. Residual effects of neuritis of the radial and peroneal nerves amounted to 0.1%. In the long-term period there were 2.1% of the knee and elbow joints contractures. **Conclusions:** Complications observed in the process of treatment of distal fractures of long bones of the extremities with the use of perosseous

osteosynthesis are not inherent this method of treatment, since they are the result of medical errors in the choice of indications for its use, violations of osteosynthesis' technique and postoperative management of patients, mainly in the period of minimally invasive technology of surgical intervention development.

Key words: perosseous osteosynthesis; errors; complications; analysis

Introduction. Distal fractures take a special place among all fractures of the long tubular bones of the extremities. The complexity of patients treatment is due to the need to perform a number of traumatic surgical interventions that involve open reposition of fragments and the use of various intraosseous and extraosseous fixators [1, 2]. However, these surgical interventions do not always guarantee a favorable outcome of osteosynthesis and the possibility of a patient's early rehabilitation. For many reasons, the greatest difficulty for specialists is the treatment of distal fractures of the long bones of the extremities (DFLBE). An inevitable companion of any surgical intervention, as well as an integral part of the work of each surgeon with fractures of this localization, are complications, among which there are contractures of large joints [3].

Many years of domestic experience in the use of perosseous osteosynthesis (POOS), as a minimally invasive technology, greatly facilitates treatment, since it allows to conduct closed management of bone fragments at any stage, regardless of the duration of the injury, the type and magnitude of their displacement, as well as early and complete functional treatment. The frequency of POOS complications according to different authors, is in the range 4% - 54% [4, 5]. Such a range, in our opinion, is due to the different approach of the authors to the concept of "POOS complications", the presence of practical experience in this method use, the severity of injury and its consequences, and associated adverse factors that allow us to speak about the frequency of diagnosed complications and methods for their prevention.

The risk of complications remains quite high, so the provision of surgical care for DFLBE necessitates research and development aimed at preventing errors and preventing complications.

The purpose: to analyze the outcomes of treatment of distal fractures of long tubular bones of the extremities, to identify the causes of errors and the frequency of complications after perosseous osteosynthesis, and to outline methods to prevent them.

Material and methods. We subjected to a retrospective analysis the results of observations of 1723 patients (men - 1074, women - 649) aged 20 - 75 years old with the

injuries under study, who were treated at the clinic of traumatology and orthopedics of the Odessa National Medical University. The period of study lasted 10 years .

The distribution of injuries according to localization was as follows: distal (extra-articular) fractures of the humerus - 647 patients, femur - 392 and lower leg bones in the lower third of the segment - 684. The use of external fixation devices (EFD) was carried out both for injuries of the extremities and their consequences. In the majority of patients (1272–73.8%), osteosynthesis with the Ilizarov's apparatus was performed within the first three days, and in the rest (451–26.2%), within 1–2 weeks or later, which is mainly due to their late admission to the clinic and the consequences of fractures. When performing POOS, epidural anesthesia and narcosis were predominantly used, which provided not only sufficient pain relief, but also complete relaxation of the muscles of the injured limb.

Due to stable external fixation of fragments of long bones of the extremities, patients from the very first days could serve themselves, engage in active and passive development of the joints and load the operated limb, which contributed to the improvement of trophism, the elimination of contractures and, consequently, their speedy rehabilitation.

Results and its discussion. The ongoing treatment of this patients' contingent with DFLBE could not but be accompanied by the development of complications. The study and analysis of long-term results of treatment allowed us to identify the frequency of complications and determine the causes of errors made after POOS.

In the course of DFLBE treatment by POOS, we noted 307 (17.82%) cases of non-severe complications of various nature in the postoperative period. As a rule, it is customary to distinguish between two main groups of complications resulting from the surgical treatment of DFLBE and their consequences. These are complications due to medical errors (ignorance of the details of the technique for performing POOS) and defects associated with the production of manufactured devices, wires and rods. The first group of complications is the main and determines the possibility of developing several complications in the same patient, which in turn can be divided into early and late.

The most common complication of POOS is inflammation of the soft tissues around the wires or rods (21.8%), which can develop both in the early or late postoperative period. The main cause of the inflammatory process in the tissues is a violation of asepsis rules and the technique of conducting wires and the introduction of rods, as well as the patient's errors in caring for the device in the postoperative period. To prevent this complication, the strictest observance of asepsis and antisepsis rules is necessary, the wires should be introduced at low speeds, while the forward force and the speed of its passage through the bone should not be

accompanied by arcuate deformation and winding of soft tissues on it, which leads to their traumatization or burns and subsequent necrosis . In the future, the inlet and outlet openings of the wires channels are regularly processed, the latter should be closed with gauze balls moistened with ethyl alcohol. If there are signs of inflammation, dressings twice a day, perifocal administration of antibiotics, antibiotics of the cephalosporin series are recommended intramuscularly, evacuation and UVR are performed. This treatment is carried out within 3-4 days. If these measures were unsuccessful, the wire was removed, the wound channel was dissected to ensure the outflow of the wound contents, and it was drained.

The cause of late soft tissue inflammation was insufficient fixation of bone fragments, which led to displacement of bone fragments along with soft tissues. Later inflammation was the result of insufficient and uneven tension of the wires. To stop late inflammation of the soft tissues, dressings were performed twice a day, antibiotics of directed action were administered. To ensure the stability of bone fragments fixation, the tightness of the wires in the structure was monitored. If the inflammatory process could not be stopped within 3-4 days, the wire was removed from the side of inflammation to prevent infection of deeper soft tissues. Then, after stopping the signs of inflammation, the wire was carried in and fixed in a taut state in the same area.

Untimely removal of the wire led to the development of wire osteomyelitis (2.3%). A predisposing factor for this is a bone burn during the wire running. When infected, aseptic inflammation turns into purulent. In this case, the wire was immediately removed, the soft tissues were dissected, and necrosectomy was performed. Feathered wires were used to prevent the development of wire osteomyelitis.

Untimely relief of soft tissue inflammation, delayed opening of purulent swells and insufficient drainage of the wound near the joint led to the development of purulent arthritis (7.8%). In mild cases, after removal of the wire, lavage was performed using antiseptic solutions and antibiotics. When the process was running and stormy, arthrotomy and drainage of the joint were performed, followed by round-the-clock washing of the joint cavity for 3-5 days.

The prolonged presence of metal in soft tissues, the use of salicylic or boric alcohol at the exit points of the wires and rods led in some cases to the development of contact dermatitis (11.4%). A consultation with a dermatologist was prescribed, antihistamines and hormonal drugs were administered. Dressings were made with a semi-alcoholic solution or dry aseptic dressings, which made it possible to eliminate this complication. The device was

dismantled in case of ineffectiveness of the therapy and the development of paratraumatic eczema.

Traumatization of vessels (0.7%) and nerves (1.0%) was the most serious complication in POOS. The risk of vessels and nerves traumatization arose during repeated operations, especially with the consequences of fractures with the presence of cicatricial changes and post-traumatic deformities of the limb. When a vessel was injured with a wire, the latter was immediately removed, and the puncture site was plugged. Diagnosis of nerve damage was simple and based on loss of hand or foot function. The wire was immediately removed and conservative treatment was performed. Traumatic neuritis developed with a wire pressure on the nerve trunk through soft tissues. Prevention of damage to neurovascular formations consisted in the doctor's knowledge of the topographic and anatomical structure of the limb segment at the level of the wires. Rod-based AVF was used to prevent neurological manifestations in the upper limb.

Incorrect placement of the pins in extra-articular injuries of the bones of the extremities contributed to the development of contractures (15.2%). Strict adherence to the established rules for passing wires through the metaphyseal zones of the segments or replacing them with rods, use of 3/4 ring supports for osteosynthesis of fractures near the joints for freedom of movement in them was a preventive measure to stop the development of contractures.

Non-compliance with the principles and techniques of AVF use led to secondary displacement of bone fragments (2.0%). The displacement of the fragments along the axis occurred in the absence of an end stop and was eliminated using the counter-lateral compression.

Late complications of POOS were associated with immobilization delays. After the dismantling of the AVF, non-compliance with the axial load regime led to limb deformity (9.8%) and refracture (5.9%). These complications indicate that the dismantling of the apparatus is unacceptable until radiologically confirmed fusion of fragments. The marked delayed consolidation (20.8%) and the formation of a false joint (1.3%) were associated with the preservation of mobility between the fragments.

The use of POOS requires constant monitoring of the dynamics of fracture consolidation, tension of the wires, maintaining stable fixation of fragments by compression after surgery and, if necessary, active intervention to stimulate consolidation in the apparatus. The introduction of devices for measuring the forces of compression, distraction, tension of the wires, as well as devices for determining the micromotion of fragments fixed in the

apparatus, will prevent the development of possible complications. Improving the quality of manufactured devices, wires and rods can contribute to the prevention of complications in POOS.

The presented analysis of clinical observations suggests that all complications after POOS were eliminated and did not affect the long-term results of treatment, and the methods for preventing complications are quite simple and allow us to recommend them for effective practical application.

Conclusions:

1. Strict adherence to the basic orthopedic postulates, a balanced, reasonable choice of therapeutic tactics and punctuality in the implementation of the perosseous osteosynthesis technique is the key to successful treatment of patients with distal fractures of the long bones of the extremities. An integrated approach, timely preventive measures, adequate physiofunctional treatment will reduce the number of complications to a minimum.

2. Complications observed during the treatment of distal fractures of the long bones of the extremities using perosseous osteosynthesis are not inherent in this method of osteosynthesis, since they are the result of medical errors in the choice of indications for its use, violations of the osteosynthesis technique and postoperative management of patients, mainly during the period of development of minimally invasive technology of surgical intervention.

Conflict of interest: The authors declare no conflict of interest and no financial interest in the preparation of this article.

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