Clinical case
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First experience with the use of a partially bioresorbable bone substitution material in a patient with 34-year old chronic osteomyelitis of the tibia

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Abstract

Introduction The most common approach to the treatment of osteomyelitic cavities (Cierny – Mader type III) is a two-stage approach proposed by Masquelet, the main shortcoming of which is the need to perform a second surgical intervention which results in a longer rehabilitation period, increased economic costs and additional emotional distress of the patient. In electronic databases, we found 17 publications devoted to the use of partially bioresorbable materials for filling in uncomplicated bone defects. The experience of treatment of chronic osteomyelitis (Cierny – Mader type III) using such materials has not been described.

Purpose Demonstration of the first use of a partially bioresorbable osteosubstituting material in a one-stage treatment of a patient with a long-term osteomyelitic process after failures of conventional surgical treatment methods.

Materials and methods We present a case of a 54-year old patient with a diagnosis of chronic post-traumatic osteomyelitis of the right leg, fistulous form, associated with contracture of the right ankle joint, 2-cm shortening of the right lower limb. A one-stage treatment technique was used using a partially bioresorbable osteosubstituting material for the first time in combination with antibacterial drugs, preselected in accordance with the patient's microbial cultures.

Results The study evaluated the use of a partially bioresorbable material impregnated with antibacterial drugs in the treatment of a patient with osteomyelitic cavity Cierny – Mader type III that achieved stable arrest of purulent and inflammatory process.

Discussion The mandatory two-stage Masquelet approach increases the surgical aggression, requires collection of an autologous bone graft, thus the risk of possible complications becomes higher. The obvious advantages of bioresorbable materials impregnated with antibacterial drugs to fill in bone defects are: no need to collect an autograft, a reduction in the number of surgical interventions to one, the possibility of gradual natural degradation of the implant from the patient's body due to bioresorption. Conclusion The study demonstrates the potential use of partially bioresorbable materials in a one-stage technology for treating patients with Cierny – Mader type III osteomyelitic cavities.

Keywords: chronic osteomyelitis, osteomyelitis cavity, one-stage surgical treatment of osteomyelitis

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INTRODUCTION

Chronic osteomyelitis is a social, sanitary-medical and economic problem of modern healthcare worldwide and accounts for up to 10 % of all pathologies of the musculoskeletal system. Treatment of osteomyelitis in most cases is labor-intensive, long-term, multi-stage, and is accompanied by frequent relapses [1, 2].

The surgical community is guided by the classification proposed by Cierny – Mader for choosing the technique of surgical intervention, according to which cystic forms of osteomyelitis belong to anatomical type III [3].

The most common treatment option for osteomyelitic cavities, reported in the literature, is the two-stage Masquelet method (induced membrane technique) [4–9]. An integral part of this method is the performance of a repeated operation: removal of the antibacterial spacer made of polymethyl methacrylate and its replacement with an osteosubstituting graft, which can lead to slow healing of fibrously altered integumentary tissues, prolongation of the rehabilitation period, increased economic costs and additional emotional stress [1, 2, 6, 8, 10].

The use of partially bioresorbable materials impregnated with antibacterial drugs in the treatment of patients with traumatological and orthopaedic profiles is poorly covered in the literature. The eLIBRARY.RU and PubMed databases contain 17 publications devoted to the use of partially bioresorbable materials in the management of uncomplicated bone defects. Treating patients with chronic Cierny – Mader type III osteomyelitis with the use of such materials has not been described yet.

Our case of using bioresorbable bone cement demonstrates the potential prospects for further study of the compatibility of bioresorbable materials and antibacterial drugs, the timing and effective impact on microflora.

Purpose Demonstration of the first use of a partially bioresorbable osteosubstituting material in a one-stage treatment of a patient with a long-term osteomyelitic process after failures of conventional surgical treatment methods.

MATERIALS AND METHODS

A 54-year-old male patient referred to the clinic of bone and joint infection of the Ilizarov National Medical Research Center of Traumatology and Orthopaedics in 2022 with complaints of a long-term functioning fistula in the middle third of the leg with exudate, and impaired weight-bearing of the right lower limb.

In the preoperative period, along with collecting anamnesis and clinical examination, the patient underwent radiography of the affected limb in two projections, analysis of the microbial cultures of the wound discharge.

At admission to the clinic, the patient's general condition was satisfactory; his body temperature was 36.6 ºC. Breathing was vesicular, no wheezing. Respiratory rate was 16 per 1 min. Heart sounds were clear, rhythmic, blood pressure was 120/80 mm Hg, pulse was 72 beats per 1 min. There were no signs of pathology from other internal organs and systems.

Case history The patient sustained an open comminuted fracture of the bones of the lower third of the tibia with displacement, complicated compartment syndrome and an extensive wound defect in a car accident 34 years ago. Due to the injury and the complications that developed, the patient underwent multiple surgeries: plastic surgery of the wound defect; BIOS; bone plating; osteosynthesis

according to Ilizarov. The treatment resulted in consolidation of the fracture but the osteomyelitic process was not arrested.

The patient moved without using additional support means or other orthopedic devices, limping on the right lower limb. The right lower limb was shortened by 2 cm due to the tibia. The skin on the anterior surface of the right tibia was cicatricially altered tissues with functioning fistula tracts in the middle third (Fig. 1 a) and purulent exudate. The function of adjacent joints was not impaired.

The microbial culture test showed growth of *Staphylococcus aureus* (10/4 CFU/ml. MSSA) in the exudate.

Radiologically, varus-recurvation deformity of 10/15° was revealed with signs of osteosclerosis in the area of the cavity defect at the level of the upper and middle thirds of the metadiaphyseal zone, irregular in shape and with clear contours (Fig. 1 b).

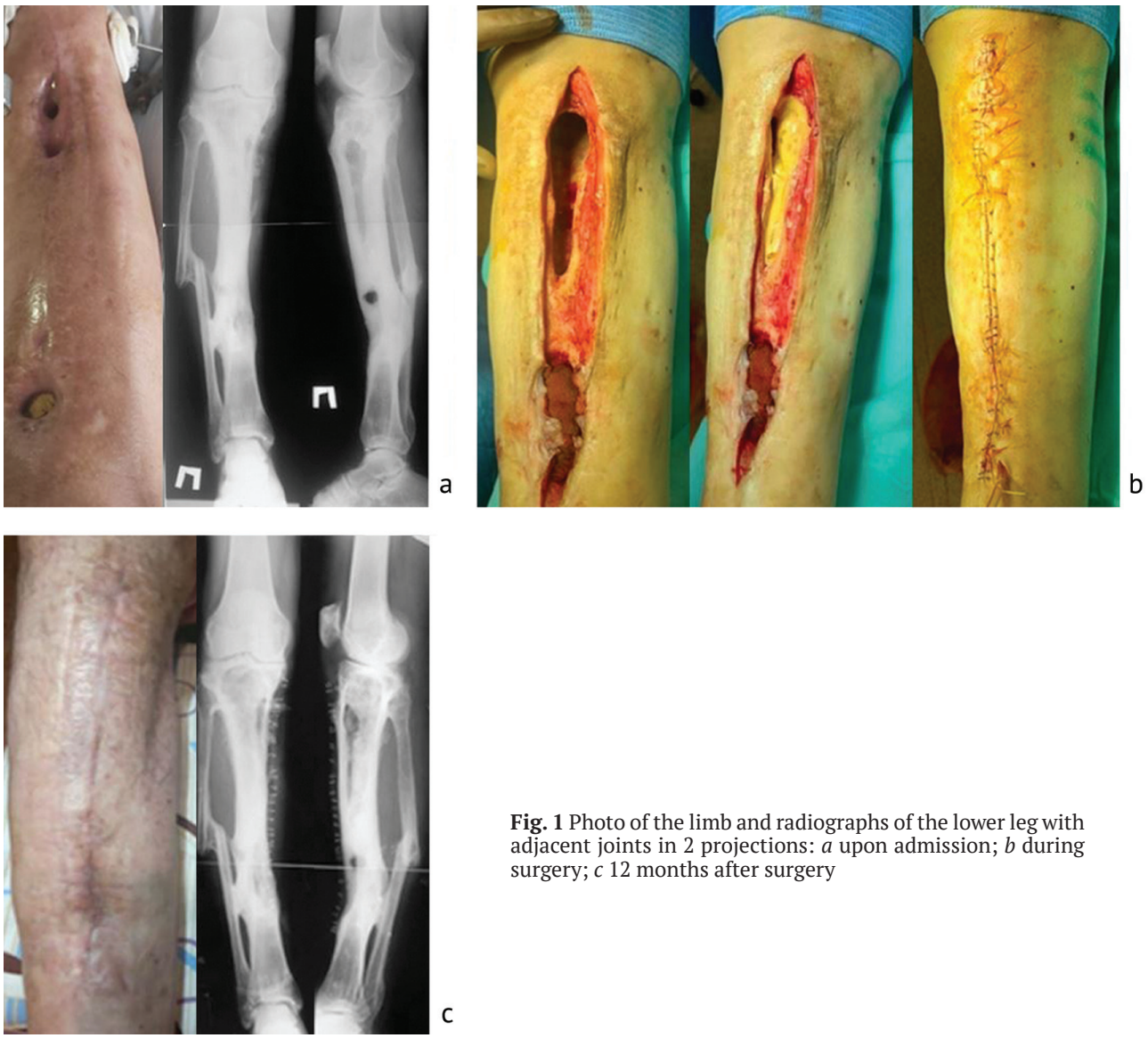

Fig. 1 Photo of the limb and radiographs of the lower leg with adjacent joints in 2 projections: *a* upon admission; *b* during surgery; *c* 12 months after surgery

The study was conducted in accordance with the ethical standards and norms of the legislation of the Russian Federation. The patient gave informed consent to participate in the study and publish the data.

Based on the obtained clinical and radiological findigs, the patient underwent surgical intervention (Fig. 1 c), during which, after contrasting the fistula tracts with the introduction of a brilliant green solution with hemostasis due to the application of a hemostatic tourniquet at the level of the lower third of the thigh, a longitudinal dissection of the skin was performed, simultaneously excising the fistula tracts along the anterior surface of the tibia. After exposing the osteomyelitic cavity, a radical sequester necrectomy was performed with subsequent lavage of the bone wound with a pulsating stream of antiseptic solution in a volume of 5 liters. Then, a partially bioresorbable spacer based on polyurethane foam impregnated with antibacterial drugs which were pre-selected in accordance with the patient's microbial culture test was implanted.

Due to the properties of the material (it increases in volume during low-temperature polymerization which lasts for 20 minutes), it was possible to fill all the free areas of the bone cavity, provide hemotamponade of the bone wound and create an increased concentration of the antibacterial drug in the osteomyelitic focus. At the end of the surgical intervention, the surgical wound was hermetically sutured; a temporary drainage system was installed.

In the postoperative period, etiotropic antibacterial therapy (Ceftazidime 2.0 per day, for 20 days), drug correction of homeostasis parameters, in accordance with the traditional treatment regimen for patients with chronic osteomyelitis, local wound care were carried out.

RESULTS

The postoperative period was satisfactory; on the 14th day the sutures were removed from the postoperative wound, and 20 days later the patient was discharged for outpatient examination by a surgeon at the place of residence.

At follow-up control 12 months after the treatment the achieved result was preserved (Fig. 1 c); the patient walks with a full weight on the operated limb, without the use of additional support means, there is no relapse of the purulent inflammatory process.

DISCUSSION

According to available literature, a bioinert polymer (polymethyl methacrylate) is mostly used for treating patients with cavitary chronic osteomyelitis (Cierny – Mader type III). There are two options of the intervention: one-stage and two-stage. The one-stage treatment approach involves implantation of an antibacterial carrier without its subsequent removal in case of arrest of the purulent process. It is necessary to note the complications arising from the use of such tactics are: osteolysis of the paraimplant zone, pain, relapse of the purulent inflammatory process with the formation of biofilms on the spacer. The two-stage treatment technology involves implantation of an antibacterial carrier for a short period (up to 2–4 months) with its subsequent removal and filling of the formed defect with auto-, allo-, xenografts, biodegradable materials. In this case, the spacer, due to the reaction to a foreign body (spacer), prevents the growth of fibrous tissue in the area of the bone defect and induces the development of the surrounding pseudo-synovial membrane (Masquelet effect) [11–19].

The properties of partially bioresorbable osteosubstituting materials described in the literature [20–23] and identified by us during the study are as follows: filling the entire space of the bone defect due to expansion during the polymerization period, maintaining the supporting function of the affected segment due to adhesion to surrounding tissues, and the possibility of using heat-stable antibacterial drugs.

Further study of the compatibility of bioresorbable material and antibacterial drugs with an analysis of the timing and effectiveness of the impact on laboratory microflora would be perspective.

CONCLUSION

Our clinical case demonstrates the successful use of a partially bioresorbable osteosubstitution material as a spacer in one-stage treatment of a patient with chronic long-term Cierny – Mader type III osteomyelitis.

Conflict of interest *The authors declare no conflict of interest.*

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Ethical review The study was conducted in accordance with ethical standards and the legislation of the Russian Federation.

Informed consent *The patient gave informed consent to participate in the study and publish the data.*

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