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Peculiarities of osteoreparation in case of bone defect replacement with bioactive glass in combination with an antibiotic

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Abstract.

This article describes the outcome of an experimental study of the bioactive glass use in combination with the antibiotic amoxicillin for osteoplasty of bone defects with an endoparodontal focus of infection. For this purpose, we created an artificial defect in a tibial bone of rabbits, which was filled with a combination of bioactive glass and the antibiotic amoxicillin. The results of the experiment of tibial bone artificial defect plasty with bioactive glass and antibiotic carried out in stages for 1, 2, and 3 months. The experiment showed that the signs of ossification and repair occur much more effectively already in the second month. In the third month of the experiment, a macroscopic study showed the new bone tissue at the site of the artificial defect is smooth, without tuberosity and does not differ from normal tissue on the incision. Histologically, there were also no signs of deformation, the boundary of the new bone at the defect area and normal bone tissue is not defined and contain a large number of osteocytes.

Keywords: ossification, endoparodontal focus of infection, osteoplasty of bone defects, osteoreparation, bioactive glass.

Introduction. The bone tissue surrounding the infected bone defect is in a state of tissue hypoxia. This fact significantly reduces its regenerative potential. In this case, the relief of acute inflammatory process comes to the fore in the tactics of the dentist-surgeon, not so much as the prevention of atrophy of the alveolar process of the jaw through the use of anti-inflammatory, antibacterial and desensitizing agents.

The standard methods of treatment of these complications are surgical intervention, removal of all foreign bodies from the focus of infection and systemic antibacterial therapy. However, prolonged systemic use of antibiotics can lead to the development of undesirable side reactions. In addition, therapeutic doses of antibiotics with their systemic use may be insufficient for local bactericidal effects on microorganisms, especially in poorly vascularized tissues and in foci of osteonecrosis, which is often observed in osteomyelitis.

If the antibiotic does not penetrate well from the implant into the tissues, this can lead to the growth of microorganisms on the surface of osteoplastic material and the formation of resistance to the antibiotic contained in it due to the very weak concentration. It has been shown that absorbable systems are capable of creating sufficient bactericidal concentrations of the antibiotic in tissues.

The **purpose** of our study was to evaluate osteoreparation under conditions of filling of a bone defect by a combination of Bioactive glass BG-1D with an antibiotic Amoxicillin in an experiment.

Materials and methods of research. After reviewing the literature data and studying the compositions of osteoplastic materials with antibiotics, we decided to choose the antibiotic Amoxicillin with BG-1D in proportion 1:9.

We used 18 white male Chinchilla rabbits of mature age. All individuals were randomly divided into 3 groups in accordance with the established observation periods of 1, 2 and 3 months. An artificial model of a tibial defect was created in all experimental animals, followed by filling it with BG-1D material in combination with an antibiotic Amoxicillin.

The course of the experiment: a 10% hexenal solution was slowly injected into the ear vein of an individual at the rate of 15 mg/ kg. After achieving deep anesthesia, the animal was fixed on the operating table and 2% lidocaine was injected locally into the upper part of the lower leg. The surgical field was treated with a disinfectant solution, the wool was shaved off, opening access to the flat surface of the upper part of the shin. Further, by making an incision of soft tissues and opening them in layers, an artificial defect with a diameter of 8-10 mm was created with the help of a micromotor with constant drip cooling of the working field. The defect was treated with Bioactive glass BG1D in combination with the antibiotic Amoxicillin in a ratio of 9:1, followed by layered suturing of the wound with catgut.

The results of the research. At the end of each stage of implantation, experimental animals were sacrificed by immediate decapitation. For subsequent morphological studies, a tibial bone with a defect in each individual was extracted.

We isolated a section of the tibial bone in the area of osteoplasty performed.

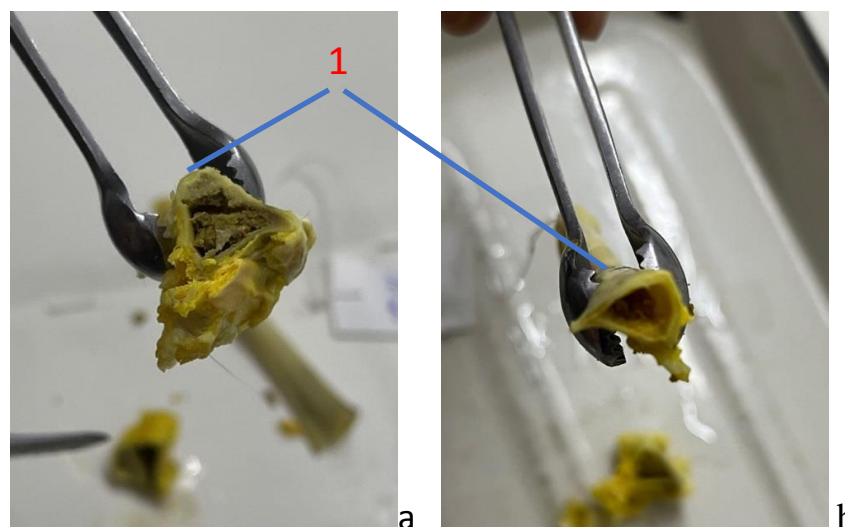


Figure 1. Macropreparations of the tibial bone in the area of implantation: a – 1 month after surgery, b - 3 months after surgery, 1 – the site of implant insertion.

On the cross-section of the macropreparation in the area of the treated defect after 1 month a significant area of elevation filled with the implant was noted. However, after 3 months there was complete resorption of the implant and a slight increase in the cortical plate volume compared to the level of healthy bone tissue (Fig. 1).

Histological study of bone regeneration after 1 month of filling an artificial defect with composition of BG-1D and antibiotic Amoxicillin revealed a large number of primitive bone trabeculae and the areas of fibrous connective osteogenic tissue among the fibroretic stroma. The stroma was well vascularized, but areas of erythrodiapedesis are observed (Fig. 2).

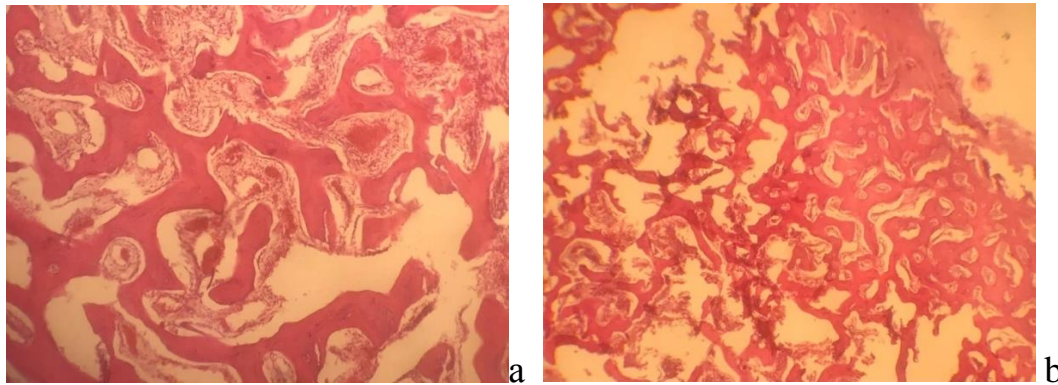


Figure 2. Histopathological sections in cortical area of tibia (experimental group after 1 month): a - original magnification 10.0x10, b – original magnification 4.0 x10.

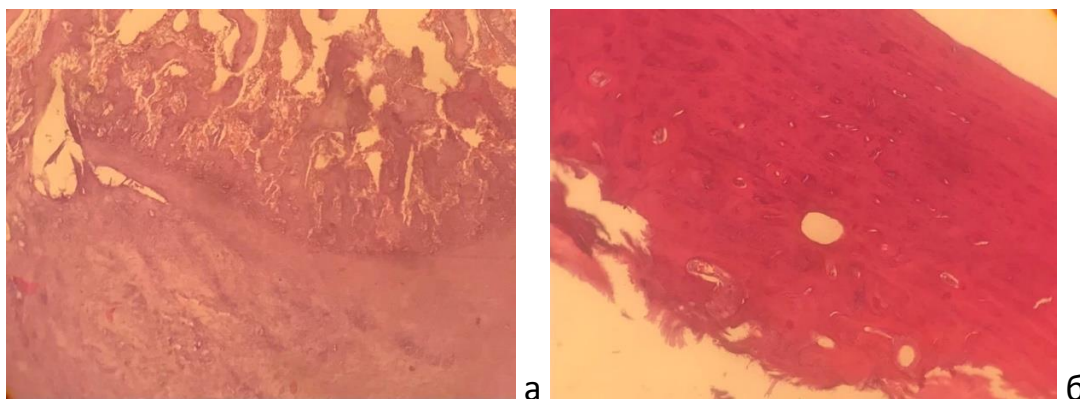


Figure 3. Histopathological sections in cortical area of tibia (experimental group after 2 month): a - original magnification 10.0x10, b – original magnification 4.0 x10.

The histological picture of the tibia after 2 month of the implantation showed the osteogenic fibrous tissue with a significant intensity of compaction, ossification, and the presence of single osteocytes. In the adjacent area, the spongy tissue is rich in weakly calcified bone beams and cellular elements of the bone marrow (Fig. 3). The border of the newly formed bone tissue and the maternal bone is blurred. There were no signs of osteogenic fibrous tissue.

On the tibial histopathological sections after three months of osteoplasty the newly formed laminar bone tissue in the area of the artificial defect is smooth, without tuberosity, does not differ from normal tissue on the incision, there is a pronounced degree of intensity of osteogenic tissue compaction with a equable

arrangement of a large number of osteocytes. The boundary of the maternal bone tissue with the newly bone is not determined macroscopically and histologically.

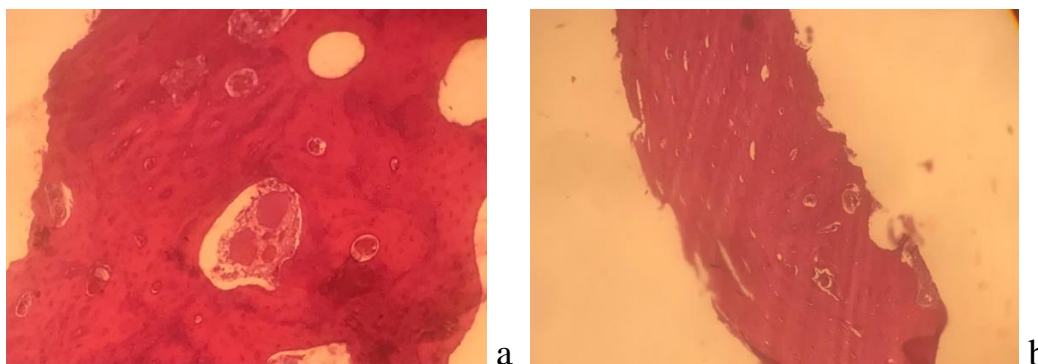


Figure 4. Histopathological sections in cortical area of tibia (experimental group after 3 month): a - original magnification 10.0x10, b – original magnification 4.0 x10.

Conclusion. Thus, the morphological study of the osteoplasty with using bioactive glass BG-1D in combination with antibiotic Amoxicillin showed biocompatibility and rapid regeneration of bone tissue.

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