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IMPROVING THE EFFICIENCY AND PREDICTABILITY OF IMPLANT TREATMENT IN CONDITIONS OF BONE DEFICIENCY

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Relevance of the Study

Tooth extraction leads to the rupture of periodontal fiber bundles, which inevitably triggers the resorption of the crestal cortical plate of the vestibular wall of the alveolus. The extent of this process depends on the thickness of the plate and the number of fibers within it (Gemonov V.V. et al., 2003). In the anterior regions of the jaws, the thickness of the vestibular wall of the alveolus rarely reaches 1 mm, and after tooth extraction it undergoes almost complete resorption (lysis) (Qahash M. et al., 2008; Vera C. et al., 2012; Wang H.M. et al., 2014).

One year after tooth extraction, atrophy of the outer cortical plate reaches approximately 25%, and within three years it may reach up to 40%. This leads to displacement of the outer compact plate toward the lingual side relative to its original position. The peak of resorptive processes affecting both hard and soft tissues occurs during the first three months after extraction.

Aim of the Study

To develop a surgical protocol for cases with bone deficiency in order to improve the efficiency and predictability of implantological treatment.

Objectives of the Study

1. Based on the analysis of clinical and radiological research methods, to evaluate the anatomical features of bone and soft tissues of the alveolar process of the jaw in the area of missing teeth.

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2. To conduct a comparative analysis of the effectiveness of osteoplastic materials in an experimental study on rabbits and to develop a protocol for their application.

Scientific Novelty

1. Based on clinical and radiological research data, the morphological characteristics of bone and soft tissues of the alveolar process in the area of missing teeth will be clarified.

2. Development of a protocol for the application of osteoplastic materials.

Materials and Methods

The study was conducted at the Department of Facultative Dentistry of EMU University and in the vivarium of the Department of Pathophysiology of EMU University.

Nine experimental rabbits of both sexes weighing 2.0–2.5 kg were used in the study. The animals were divided into the following groups:

1. Rabbits with autografts (AT) – 3 animals.
2. Rabbits with lyophilized grafts – 3 animals.
3. Rabbits with a tissue construct containing multipotent mesenchymal stem cells – 3 animals.

All experiments were carried out in accordance with the laboratory practice regulations of the Republic of Uzbekistan.

During the experiment, under anesthesia, a fragment of the outer cortical plate of the mandible (4×4 mm) was removed. Depending on the experimental group, an appropriate transplant was placed into the resulting defect.

Before collecting material for histological examination, computed tomography was performed. The examinations were conducted at the

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Department of Radiology of EMU University using a multislice computed tomography scanner.

For histological analysis, fragments of the mandible containing the surgical area were excised within healthy tissue boundaries. The collected tissues were fixed in a 10% neutral formalin solution, decalcified in EDTA, and embedded in paraffin. The sections were then stained with hematoxylin and eosin.

The primary objective of the study was to evaluate the effectiveness of bone regeneration in the repair of bone defects using three types of implants: autogenous bone, demineralized lyophilized bone matrix (DLBM) obtained from rabbit cancellous bone, and DLBM seeded with multipotent mesenchymal stem cells derived from rabbit bone marrow.

The observation period included three time intervals ranging from 2 to 15 weeks in order to evaluate both short-term and long-term outcomes.

Results

According to MSCT results, at 2–4 weeks initial signs of peripheral osteorepair were observed in all cases, manifested as indistinct and irregular contours of the defect.

In the autograft (AT) group, the configuration of the post-resection defect remained almost unchanged compared with the initial state.

The most pronounced changes were observed in the second and third groups, which was evidenced by a reduction in the size of the defect.

At 6–8 weeks after surgery, in the AT group the post-resection defect had noticeably decreased in all observations, and signs of autograft remodeling were observed.

In the DLBM group, in half of the cases complete closure of the post-resection defect was observed, with the formation of a thin cortical layer.

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By week 15 after surgery, the post-resection defect was absent in all three groups. However, in the first group the cortical layer appeared somewhat deformed and thinned.

In the second group (DLBM), the thickness of the cortical layer corresponded to that of intact bone.

In the third group (DLBM + mesenchymal stem cells), complete restoration of the defect was observed. The newly formed cortical layer matched the intact cortical bone in both thickness and density characteristics.

Conclusions

Transplantation of demineralized lyophilized bone matrix containing stem cells resulted in the density of newly formed bone approaching that of intact bone.

Implantation of DLBM alone into the surgical defect area is insufficient for the formation of fully developed bone tissue in the repair zone, since even in long-term observations the newly formed bone retains the structure of cancellous bone.