Bone tissue regeneration using different 3D matrices

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Introduction. There are several types of grafts used in the treatment of bone defects [1]. During the research, was tested the regeneration capacity of critical bone defects with several types of materials.

Materials and methods. To 18 New Zealand rabbits, under general anesthesia in both parietal bones, 8 mm in diameter critical defects were made. In the defects made in the right parietal bones were transplanted (n=3): collagen sponges cross-linked with 25% glutaraldehyde (GA) vapours, collagen sponges cross-linked with 25 mM riboflavin under UV-A [3], lamellas of demineralised bone matrix (DBM), shredded DBM [2], and 3D printed PLA discs; the control materials were transplanted in defects made in the left parietal bones: minced autologous iliac bone and Colapan. The rabbits were removed from the experiment at 12 weeks, the calvarias were fixed in 10% buffered formaldehyde. The regenerated defects were examined histologically by Hematoxylin-Eosin staining, and scanning electron microscopy (SEM) [4].

Results. The histological examination of defects treated with minced autologous bone showed an inflammatory process with necrosis and resorption of transplanted bone trabeculae. In defects treated with Colapan formation of bone trabeculae in the areas of contact with the native bone was determined. The defects treated with cross-linked collagen sponges showed a dense and regularly distributed collagen fibers when using GA and degenerated, loose with thin fibrillar structure for riboflavin. When DBM lamellas were used, debris of DBM matrix and disorganized fibrous connective tissue with an infiltrative character were found. The shredded DBM fragments were consolidated with fibrous tissue and at the periphery of the fragments, trabecular extensions of newly formed bone were determined. In spaces between filaments of PLA discs were found thick collagen fibers forming bundles and newly formed trabeculae of reticular fibrous bone. SEM showed that transplanted materials changed significant their structure except the PLA discs.

Conclusions. The difference between the obtained results showed that not all materials can be used for an efficient regeneration of critical bone tissue defects. Compared to the control and the other experimental groups, shredded DBM at 12 weeks filled the defect with bone-like tissue.

Keywords: critical defects, bone regeneration, 3D matrices.

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