BIOMATERIALS SEEDED WITH STEM CELLS USED IN OSTEO-CARTILAGINOUS REGENERATION

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Musculoskeletal diseases are considered to be in the first two causes of invalidity in our days. In this context, the need to continue research to obtain alternative solutions for the effective treatment of fractures and critical bone defects is important. The first step in this approach is to better understand bone regenerative processes from the time before bone injury to complete bone regeneration. It is also extremely important to study the types of implants adapted for the treatment of bone defects and their interaction with the receptor.

The aim of this paper is to study in detail the regenerative bone processes, the superior histological results of early cure and the efficiency of two types of implants - based on bioactive glass and collagen - in the treatment of critical bone defects.

The basic element of the human skeleton is bone, a rigid material composed mainly of collagen fibers impregnated with calcium phosphate-like minerals . At first glance, the bone appears to be an inert organ, but a more detailed study reveals that the bone is a dynamic structure, composed of both living tissue - bone cells, fat, blood vessels - and chemical elements such as water and various minerals.

Bone tissue consists of an organic component (25-30%), an anorganic component (50%) and water (20-25%).

The bone is a dynamic structure involved in a continuous process of remodeling and renewal. This remodeling process is supported by the successive action of osteoclasts that resorb bone tissue and osteoblasts that produce new bone tissue. These two processes are very well controlled so that the total bone mass in a mature human skeleton remains constant, despite the fact that 3% -5% of bone calcium deposits re-enter each year.

The ability to regenerate the bones is sufficient in the case of low-displacement simple fractures, which are reduced and immobilized correctly.

Critical bone defects caused by trauma, infection, excision of bone tumors, skeletal malformations, compromise the proper functioning of bone regeneration due to avascular necrosis, bone atrophy, or osteoporosis.

Tissue bioengineering and regenerative medicine are new areas of research at the intersection of biology, physics, materials science, engineering, and medicine. In the context of

bone regeneration, they aim to find new and effective solutions and approaches for treating major bone defects.

As a schematic approach, bone tissue bioengineering uses mesenchymal stem cells seeded in scaffolds, which are preferred to be three-dimensional - for better osteoconductivity and revascularization - in combination with various growth factors.

The aim of our experiment is to test in vivo the efficacy of two alternative treatment options for critical bone defects:

- Biological matrix implant and
- Bioactive glass implant

Both seeded with stem cells derived from autologous adipose tissue.

The cranial bone was harvested and analyzed:

- according to the a score proposed by us;
- MRI for tissue structure determination (non-degrading tissue test);
- histologically in hematoxylin-eosin

The results obtained shown a slightly better outcome for the specimens treated with collagen matrix seeded with MSC.

The lack of implant rejection demonstrates high bio-compatibility for these two implants, which is why we can think about testing them and other types of defects such as soft tissue defects.

The presents of collagen fibers and bloody cells are incipient signs of healing bone defects. Not having the certainty of the type of cell in which the implanted stem cells differentiate, we did not notice the occurrence of bone neoformation using this examination methods. In this direction, as future plans, we propose an immunohistochemical evaluation of harvested tissue to obtain an accurate qualitative and quantitative analysis of newly formed collagen fibers (type 1 collagen, type 2 collagen, glycosaminoglycans).

For better control of stem cell differentiation to the osteoblast line, growth factors such as bone morphogenetic protein (BMP-2), FBF-2 fibroblast growth factor, IGF-1-like insulin-like growth factor or Transformation growth factor (TGF-β-1) can be used in future studies.