3D MOLDABLE SCAFFOLD AS A NEW PLATFORM FOR BONE TISSUE ENGINEERING STRATEGY WITH IMPROVED HANDLING PROPERTIES

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ABSTRACT

Three kinds of putties for bone regeneration are compared in this study. Two formulations are ready-to-use and one is a powder to be mixed (Freeze Dried Bone Scaffold) with either a physiological solution or with biological agents for a tissue engineering approach. The main differences between the formulations concern the hydroxyapatite/β-tricalcium phosphate ratio of biphasic calcium phosphate (BCP) as mineral filler, the proportion of polymer gel as a carrier, and the method of sterilization.

The rheological and handling aspects demonstrate that the new formulation FDBS leads to higher moldability and cohesion properties than the ready-to-use putties, especially with blood or Platelet Rich Plasma (PRP) associations. The biocompatibility and biofunctionality of FDBS are proved by *in vivo* results (in rabbit femoral epiphysis model with and without osteonecrosis).

As a conclusion, FDBS displays essential performances to be considered as a new platform for bone tissue engineering.

Keywords: Biphasic Calcium Phosphate, putty, tissue engineering, platelet-rich plasma, osteonecrosis rabbit model

INTRODUCTION

Many clinical situations need materials to restore and regenerate bone, and be able to replace the use of autologous bone graft. In spite of large innovations in the last 30 years, optimization of synthetic bone substitutes is still required to get an efficient alternative to the autograft, the gold standard. This is due to limitations such as blood loss, longer surgical time, infection and limited quantity of graft material [1].

Results from clinical trials using a tissue engineering strategy demonstrate a promising challenge for the use of autologous mesenchymal stem cells (hMSC) combined with highly bioactive calcium phosphate granules [2] [3]. As described in the last decades, the use of hMSC is not the sole strategy in bone tissue engineering regeneration. Blood, total bone marrow (TBM), PRP, and many growth factors could be other interesting choices for scaffold combinations [4].

The design of new scaffolds [5] has to be more suitable for tissue engineering and simultaneously improving the usability for surgeons. It appears that the handling and the ease of use of a bone medical device (MD), such as injectable paste or moldable putty, is greatly anticipated [6]. Today, bioactivity of the synthetic bone substitutes present a crucial challenge in clarifying and applying the concept to new developments. This would improve future osteogenic/osteoinductive bone graft substitutes [7].