

THE IMPACT OF HYDROXYAPATITE SINTERING TEMPERATURES ON THE STRUCTURAL AND FUNCTIONAL CAPACITY OF EMBRYONAL LUNG FIBROBLASTS

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ABSTRACT

The specific aim of this investigation was to investigate the effects of hydroxyapatite (HA) sintered at different temperatures on the proliferation, morphology, and cellular alterations of Embryonal Lung Fibroblasts (MRC-5) cells in culture. Microcrystals of HA were prepared by following standard laboratory protocols. The calcined HA was then placed on an automatic Tyler sieve stack to select for particles between 1-40 μm in size. The calcined material was sintered at 700, 1000, 1200 and 1300 °C for 24 hours. The sintered material (1.0 grams of HA) was added to a total of 20 mg of L-lysine as a binder. Finally, this combination was cold-pressed into cylindrical form using a 3/8 inch die set at a compression load of 5000 kg to form a disk of HA. Calculated density of the devices was directly proportional to temperature of sintering. MRC-5 fibroblasts were obtained from the American Type Culture Collection (ATCC). Proliferation Assessment, morphological evaluations were conducted following standard lab protocols. Cells were analyzed for Maliondialdehyde (MDA) levels by utilizing thiobarbituric acid reactive substance (TBARS) measurements. Results of this study revealed that there was an initial (at 24, and 48 hours) increase in proliferation rate observed in wells containing HA sintered at 700, 1000, and 1300°C. There were no significant differences in proliferating cells among control and capsules sintered at 1200°C ($P<0.05$). However, at 72 hours there was 2-3 fold increase in cell number for the cells encountering 1200°C compared with control and experimental wells. Cellular membrane damage was evident in cells exposed to HA sintered at 700, 1000 and 1300°C, but not for control or HA 1200°C treated cells. Morphologically, the cells showed evidence of progressive fragmentations, cellular debris and lysis at 72 hours for cells in the HA sintered groups of 700, 1000 and 1300°C. HA sintered at 1200°C did not cause changes in cell morphology for the duration of the experiment. In conclusion, the results of this investigation suggest that sintering temperature is essential factor in the development of a high mechanical strength HA delivery systems**.** The results from this observation and our previous findings using different calcium phosphate devices suggest that the use of optimal HA density is crucial for material constructs to replace or repair tissue defects.

Keywords: HA Ceramic Delivery Systems, HA, morphology, Drug Delivery, MRC-5, Bioceramics, Calcium phosphates

INTRODUCTION

In recent years, the use of Bioceramics in dental and orthopaedic fields have received remarkable attention [1-7]. This can be attributed to the ceramic materials favourable properties to an *in vivo* environment. These includes corrosion resistance, ease of fabrication [3-9], and hardness, to name afew. Furthermore, the growing trend toward using the ceramic materials as implantable devices may just be the shape of things to come. Unlike other implantable materials, several studies have shown that ceramic particles produce less cell reaction than extensively used polymer or metal particles. Previous studies conducted in our laboratories [1-18] and others have suggested that in designing compatible ceramic devices, it is essential to devote special attention toward providing a proper response to ceramic-implant interface. Ideal implantable ceramic-based devices must be highly acceptable by the host in order to ensure highest and prolonged functional activity of surrounding tissues. The hypothesis of this investigation elutes that porosity and mechanical strength of hydroxyapatite (HA) ceramic drug delivery devices is highly impacted by the temperature of sintering