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Rat Adipose-Derived Stem Cell Behavior on Fluoridated Hydroxyapatite Bone Substitutes

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Introduction:

Bone grafts are used to aid bone repair and regeneration in various surgeries ranging from dental implants to limb salvaging operations. Our group has been conducting research bone substitutes composed of hydroxyapatite and two fluoridated variants. These materials are representative of the various fluoridated forms of hydroxyapatite, which is a mineral found in bone and teeth. We have previously shown that both keratinocytes and osteoblasts adhere to and osteoblasts differentiate on our varying biomaterial surfaces. The goal of this project is to analyze cell proliferation and differentiation of rat adipose-derived stem cells (ADSC) on pellets made from fluorohydroxyapatite (FHA; Ca10[PO4]6FOH), fluorapatite (FA; Ca10[PO4]6F2), and hydroxyapatite (HA; Ca5[PO4]3OH).

Methods:

The powder for the pellets (FHA/FA/HA) was synthesized and sintered at either 1150 or 1250 degrees Celsius, which directly impacts the crystalline structure of the pellets. For the course of this study, the pellets and a control titanium disk (Ti) were plated with rat ADSC (1,316 cell/cm^2) and incubated for 2- or 10-days. Cell proliferation was measured via an alamar Blue assay, with all data reported relative to titanium control. Cell proliferation was compared between the different materials using an ANOVA followed by a Tukey's post hoc test.

Results/Conclusion:

At two days post plating cell proliferation was statistically greater on the HA1150 pellets (156%±8%) compared all other surfaces (100± 10%; $p<0.05$). However at 10 days post plating the HA (142±25), FA (149±14), and FHA (141±17) sintered at 1250°C and FA (143±22) sintered at 1150°C had statistically greater cell proliferation compared to the titanium control (100±10%; $p<0.05$). While there was no difference between the FHA (121±2%) and HA (124±2%) 1150°C and titanium ($p>0.05$). Future work will evaluate number of cells adhered to the different surfaces, as well as protein (western blot) and gene expression markers (RT-PCR) linked to differentiation of cells to an osteoblast's lineage.