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POUROUS FLUORAPATITE SCAFFOLDING WITH ADIPOSE DERIVED STEM CELLS BONE GRAFT

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ABSTRACT: The annual frequency of approximately 6.3 million fractures demonstrates that bone injuries in the United States are of high medical interest. Often fracture injuries are treatable through non-invasive means. However, sometimes these injuries result in critical-size defects– defined as the size of an osseous defect that does not heal spontaneously with bone during the lifetime—which needs surgical interventions with bone replacement scaffolds. There are three types of bone replacement scaffolds currently used in medicine: 1) autografts, 2) allografts, and 3) engineered bone grafts. Although autografts are ideal, they are in short supply and need a second surgical site. Allografts fail in larger defects, partially because they do not contain the same cells as an autograft. Thus, a need to develop ideal engineered bone grafts arises. Ideal engineered bone grafts are not only made to provide strength but also to serve as base structures for bone regrowth and have the ability to bio-resorb. In this study, we fabricated hydroxyapatite and fluoridated apatite-based scaffolds (FA), combined them with a patient's own stromal vascular fraction (SVF) cells, a heterogenous mixture of cells within adipose tissue where usable undifferentiated stem cells are found, and tested the ability of the surfaces to regenerate bone tissues. The rationale for this study was to engineer the scaffolds to have similar regenerative properties as autografts with the addition of stem cells, the hypothesized end result being a significant and observable difference in regrowth of injured bone between scaffolds, with the FA scaffold/SVF cell combo performing the best. This concept was tested in a rat femoral defect model with the defect left untreated, treated with autograft, FA scaffold, or the FA scaffold/SVF cell combo (n=6/group). The rats were monitored using micro-CT at two-week intervals, and percentages of new bone formed with the defect were calculated. The data so far has shown that SVF cell extractions from both rat and human samples are adhering to the FA scaffolds uniformly (scaffolds incubated with the highest concentration of cells have more cells adhered). SVF cell extraction protocols used have also been proven to work, which can be inferred from both FACSCanto and Cytek Aurora data gathered. These promising findings indicate that using FA manufactured scaffold with SVF cell extraction containing adipose-derived stem cells could be a viable surgical treatment for future medical use.