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PHYSICAL CHARACTERIZATION AND IN VITRO CYTOTOXICITY STUDIES OF POLY(E-CAPROLACTONE) SCAFFOLDS OF HIGHLY CONTROLLED POROSITY FOR NONUNION BONE FRACTURE REPAIR

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Large gaps in bones due to the tumor resection as well as fractures that are difficult to stabilize can induce the formation of non-unions, which represent an unmet need in orthopedics and require novel tissue engineering treatments. An ideal implant would be a biodegradable biomaterial that is osteoconductive while providing appropriate mechanical support during tissue growth and implant resorption. Porous scaffolds of Poly(ε-caprolactone) (PCL) may be able to satisfy these requirements and promote bone repair. Porous scaffolds of PCL have been fabricated via melt blending with Poly(ethylene oxide) (PEO) at co-continuous composition followed by static annealing at different temperatures and for different annealing periods. Finally these blends are subjected to the selective extraction of PEO in water in order to obtain highly controlled porosity and pore interconnectivity. A wide range of pore sizes, of controlled size distribution, varying from 1 up to more than 250 µm can be generated by this technique. Furthermore, the porous structure can be made to exhibit virtually 100% interconnectivity. Exposure to 70% ethanol, as a sterilization technique, showed no adverse effect on the porous structure whereas steam autoclave collapsed the whole skeleton of the scaffold. Preliminary studies of cell infiltration inside the porous network have been conducted using 10 µm polystyrene beads as a model system for trypsinized Human Bone Marrow Stromal Cells (H-BMSCs). This preliminary work with beads will help to identify the pore size requirements for optimal retention in the scaffold to enable H-BMSCs to adhere and form attachments to the polymer surface. Cell attachment, cytotoxicity, and proliferation will be analyzed using L929 mouse fibroblasts while osteogenesis will be analyzed using primary passaged H-BMSCs. This knowledge will allow us to optimize the polymer's surface and network properties in order to create novel 3-D scaffolds for potential clinical use in bone repair.