Engineering and Evaluation of 3D Printed Polymer Scaffolds for Bone Tissue Regeneration

Jayatissa, Nipun

The regeneration of bone defects caused by trauma, fracture, and disease is a significant clinical challenge for both military and civilian patients in the United States and around the world. The ideal scaffolds for bone tissue repair should provide biocompatibility, pore architecture, biodegradability, mechanical support, and cell attachment sites. Conventionally fabricated polymer scaffolds are still unable to make ideal scaffolds for bone tissue repair. In this study, relatively new 3D printing technology was used to print porous polycaprolactone (PCL) scaffolds. The hypothesis of this study is to engineer 3D printed porous PCL scaffolds that can mimic porosity, pore morphology, mechanical properties, biocompatibility and cell attachment similar to human bone. Three different types of PCL scaffolds with pore sizes 200 μm, 400 μm, and 800 μm were designed using a computer software. These scaffolds were characterized for percent porosity, pore architecture, morphology, mechanical properties, and evaluated for biocompatibility and cell attachment with murine osteoblasts. The percent porosity of these scaffolds (n=7) has significantly increased from 13.31 to 61.66 ($p<0.001$) with the increase of pore sizes. The average compressive modulus of scaffolds (n=7) significantly decreased with the increase of pore sizes ($p<0.001$). The averaged compressive modulus of scaffolds with 200 μm, 400 μm, and 800 μm pores is 82.98 ± 2.02, 61.60 ± 2.59, and 47.16 ± 1.73 MPa, respectively. In addition, PCL scaffolds show biocompatibility and cell attachment as determined by in vitro murine osteoblast study. Potentially 3D printed porous PCL scaffolds can be used for bone regeneration applications