

Bone tissue regeneration using 3D printed microstructure incorporated with hybrid nano hydrogel

Dong Nyoung Heo, Se-Jun Lee, Lijie Grace Zhang*

Department of Mechanical and Aerospace Engineering, The George Washington University, DC 20052, USA

Background & Objective

Three-dimensional (3D) functional constructs with biomimetic and biomechanical properties are ideal for various tissue regeneration. Aforementioned properties of 3D fabricated constructs mainly depend on the intrinsic attribution of used materials and the fabrication methods. In this respect, current use of hydrogels for damaged tissue repair in the musculoskeletal tissue are not perfect due to the lack of suitable mechanical properties, as well as the high biomimetic requirement for successful regeneration. To overcome the drawback, we developed a novel functionalized hydrogel with bioactive gold nanoparticles (GNPs) and further reinforced with highly mechanical strength microstructure via a fused deposition modeling (FDM) 3D printer for bone tissue regeneration.

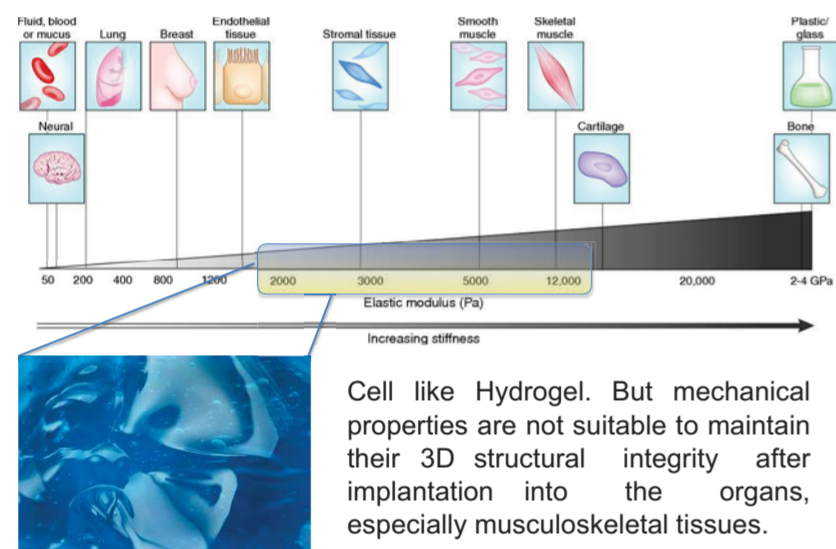


Figure 1. Variations in tissue stiffness, from Ref. [Disease Models and Mechanisms 4.2 (2011): 165-178]

Scaffold design and Fabrication

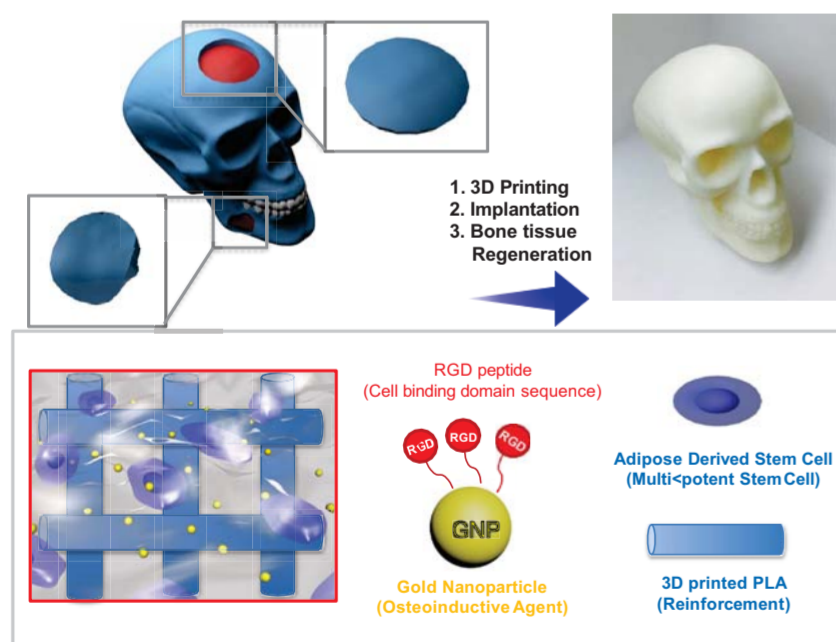


Figure 2. Patient-specific Bone tissue regeneration using 3D Printing PLA incorporated with hybrid hydrogel composed of gold nanoparticles and human adipose derived stem cells

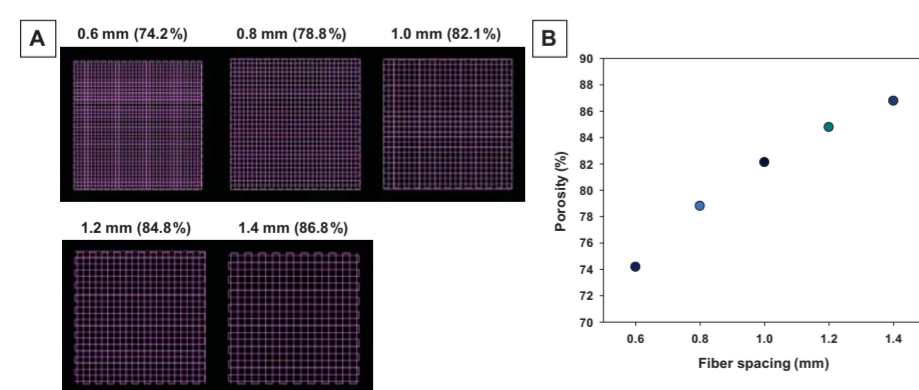


Figure 3. (A) Pre-designed 3D scaffolds and (B) their porosity

Characterization

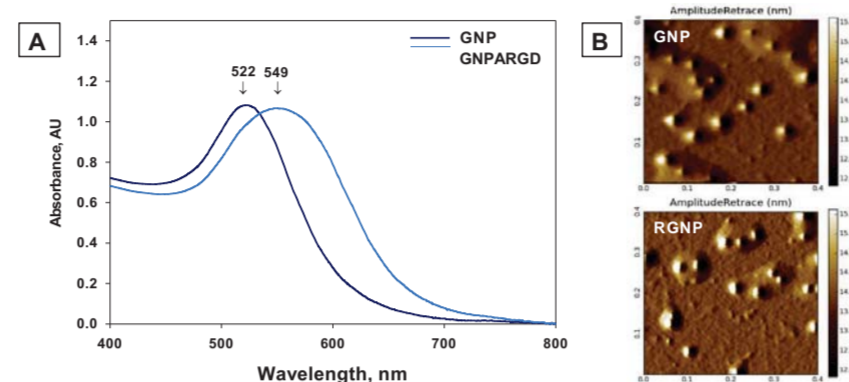


Figure 4. Synthesis and Characterization of cRGD conjugated Gold Nanoparticles (GNP) by (A) UV spectrometer and (B) TEM.

