3D PRINTED COMPOSITE SCAFFOLDS FOR SEGMENTAL BONE DEFECT: FABRICATION AND MECHANICAL EVALUATION

Swathi Sadashiva[1] , Parichita Mishra[1], Bhisham Narayan Singh[1*]

Department of Biotechnology, Manipal School of Life Sciences, Manipal Academy of Higher Education, Manipal, Karnataka, India 576104

*Corresponding author

ABSTRACT:

Segmental bone defect with delayed union often leads to non-union defect without medical intervention. Current management strategies often require repeated surgeries and some leads to critical condition and often the failure of bone healing. Tissue engineering comes into play in artificially structuring the bone architecture with biological compatibility. Despite many ways, 3D printing has gained great attention in delivering artificial grafts due to its ability to create structures with sustained pore size and architecture according to the requirements. In this study, the composite of polymer polycaprolactone with greater toughness and nanohydroxyapatite with greater bone bonding efficiency are combined to form the ink. The designs to mimic the radial gradient pattern of bone were printed. The physicochemical characterization has been performed to show the porosity (78-82%) and pore size gradients (900 µm- 200 µm), mechanical ability (compressive strength at 40% strain 10MPa- 15MPa) to withstand the load to mimic the bone appropriately. The printed structures were also shown to be biocompatible (Human umbilical cord-derived mesenchymal stem cells). This study highlights the potential of the fabricated structures to address the challenges posed by delayed union in segmental bone defects, offering a promising avenue for effective medical interventions and improved bone healing outcomes.

Keywords: Bone tissue engineering, 3D printing, Radio-opaque nanocomposites, Polycaprolactone, Hydroxyapatite

Acknowledgments: The authors thank the CSIR-JRF fellowship. We thank DST-SERB for the project funding and the Manipal School of Life Sciences, Manipal Academy of Higher Education for providing the necessary support and facilities.