Designed Biomaterial Devices for Limb Salvage Implant for Distal Femur, Proximal Tibia and Proximal Femur by Dr. Bikramjit Basu, Indian Institute of Science (IISc), Bangalore

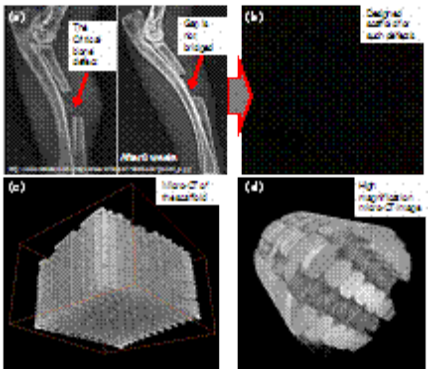

Figure: X-ray radiograph of the large sized bone defect, (b) 3D porous scaffold, and (c-d) micro-CT of the porous scaffold, showing the interconnected pores.

The bone fractures due to skeletal disorders is traditionally treated by reconstruction of bone using temporary or/and permanent implants. Mechanical stabilization of the fracture site is one of the requirements for healing. In case of large bone defects (critical size defects), the bone regeneration is often insufficient to completely fill the defect site even after mechanically stabilization, resulting in non-union of bone. These defects need to be filled with a scaffold to enable regeneration. The scaffolds for bone tissue engineering are essentially characterized by porous three dimensional (3D) structures with interconnected pores to facilitate the exchange of nutrients and removal of waste products from cells, thereby felicitating cell proliferation well into such engineered scaffolds. Although hydroxyapatite (HA) is widely being considered for bone tissue engineering applications due to its excellent bioactivity and osteoinductive properties, limited reports are available on the additive manufacturing of bulk monolithic HA. While addressing various issues in the above-mentioned human healthcare perspective, the ongoing project demonstrates the usefulness of additive manufacturing for fabrication of clinically relevant 3D biomaterial scaffolds with pre-defined porosity. These scaffolds are characterized as having a large scale macroporosity (~44 % in sintered scaffolds). Some salient results are summarised in the Figure. Interestingly, it has been demonstrated that with the use of complex architecture of porous scaffolds, a better compressive strength together with progressive failure under static loading can be obtained. The project also demonstrates how to address various process related challenges in terms of the optimization of binder properties (viscosity, pH), as well as, post-processing treatment to obtain desired porous architecture and properties. While charactering various properties, the use of micro-computed tomography as well as 3D culture bioreactor has been extensively made.