National Institute of Technology Rourkela

Progress Seminar

Seminar Title	: Functionally graded tissue-engineered graft for osteochondral defects
Speaker	: Shreya Chrungoo (Rollno : 520bm3012)
Supervisor	: Prof. Devendra Verma
Venue	: Seminar Hall, BM Department
Date and Time	: 27 Jan 2025 (3:30 PM)
Abstract	: The structural organisation of mammalian organisms exhibits a feature characterised by continuous gradients involving various biological components, such as cells, proteins, growth factors, and the extracellular matrix. For instance, the osteochondral interface of the joints displays a gradual variation in tissue composition, with a gradient spanning from bone to cartilage tissue. Tissue engineering and 3D bioprinting hold great potential in transforming orthopaedic healthcare. Utilisation of native tissue-mimicking biomaterial-based scaffolds can eliminate the risk of graft rejection and potentially overcome the drawbacks associated with the current standard treatments of osteochondral defects. Nevertheless, establishing bioprinted scaffolds replicating the native gradient patterns remains a formidable challenge. Therefore, this study aims to develop bioinks which can be used to 3D bioprint a gradient hydrogel scaffold that mimics the gradient architecture of an osteochondral interface using a gradient 3D bioprinter. Protein-polysaccharide-based composite bioinks were developed using bovine serum albumin and sodium alginate. Additionally, self-assembled nanofibrous polyelectrolyte complexes (PECs) were incorporated into the bioinks to enhance cell attachment sites and mimic the native extracellular matrix. The bioinks were successfully fabricated with excellent printability, high shape fidelity and enhanced mechanical properties. Due to the excellent shear-thinning property of the fabricated bioinks, the post-printing cell viability is not affected. MG63 pre-osteoblasts and primary chondrocytes were encapsulated in the bioinks to observe proliferation within the bioprinted constructs. Furthermore, bioinks were optimised for the proliferation and differentiation of bone marrow mesenchymal stem cells (BM-MSCs) in the hydrogel scaffolds. The subsequent phases of this investigation will involve exploring the differentiation of BM-MSCs within the 3D printed gradient scaffolds, followed by an evaluation of the scaffold's in vivo efficacy in repairing osteochondral defects in animal models.