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# Multi-compartment scaffold fabricated via 3D-printing as in vitro co-culture osteogenic model.

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**Abstract**

The development of in vitro 3D models to get insights into the mechanisms of bone regeneration could accelerate the translation of experimental findings to the clinic, reducing costs and duration of experiments. This work explores the design and manufacturing of multi-compartments structures in poly(ε-caprolactone) (PCL) 3D-printed by Fused Filament Fabrication technique. The construct was designed with interconnected stalls to host stem cells and endothelial cells. Cells were encapsulated within an optimised gellan gum (GG)-based hydrogel matrix, crosslinked using strontium ($Sr^{2+}$) ions to exploit its bioactivity and finally, assembled within compartments with different sizes. Calcium ($Ca^{2+}$)-crosslinked gels were also used as control for comparison of $Sr^{2+}$ osteogenic effect. The results obtained demonstrated that $Sr^{2+}$ ions were successfully diffused within the hydrogel matrix and increased the hydrogel matrix strength properties under compressive load. The in vitro co-culture of human-TERT mesenchymal stem cells (TERT- hMSCs) and human umbilical vein endothelial cells (HUVECs), encapsulated within $Sr^{2+}$ ions containing GG-hydrogels and inter-connected by compartmentalised scaffolds under osteogenic conditions, enhanced cell viability and supported osteogenesis, with a significant increase of alkaline phosphatase activity, osteopontin and osteocalcin respect with the $Ca^{2+}$-crosslinked GG-PCL scaffolds. These outcomes demonstrate that the design and manufacturing of compartmentalised co-culture of TERT-hMSCs and HUVEC populations enables an effective system to study and promote osteogenesis.

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# New Approaches to Treat Osteoarthritis with Mesenchymal Stem Cells.

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**Abstract**

Osteoarthritis is one of the most common chronic health problems in the world that causes disability and chronic pain with reduced mobility and is a progressive degenerative disease in weight-bearing joints such as the knee. The pathology of the joint resulting from OA includes loss of cartilage volume and cartilage lesions leading to inflammation of the articular joint structures; its incidence and progression are associated with a variety of risk factors. Most of the current treatments focus on symptom management such as physical and occupational therapies, pharmacological intervention for pain management, and surgical intervention with limited success and do not address nor halt the

progression of the disease. In this review, we will describe the current treatment options for OA and the exciting new translational medical research currently underway utilising mesenchymal stem cells for OA therapy.