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Auto-inductive scaffolds: Orthogonal grafting of different peptides to scaffolds for concurrent differentiation of cells to multiple lineages

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Inadequate vascularity limits the supply of oxygen and nutrients to the central part of tissue engineered (TE) scaffolds, which often leads to poor and non-uniform formation of extracellular matrix (ECM). Synthetic materials provide enormous flexibility in designing matrices with well-defined physio-mechanical and biological properties but they lack bioactive recognition ligands to support cell-matrix interactions required for adhesion, proliferation, differentiation, and maturation of the seeded cells. This limitation can be overcome by orthogonal conjugation of different types of bioactive ligands or partial sequences of ECM proteins to the synthetic matrix. The focal adhesion RGD amino acid sequence interacts with integrin-binding receptors on the cell surface to induce spreading and adhesion of seeded cells to the matrix. The OPD peptide corresponding to amino acid residues 162-168 of osteopontin induces vasculogenic differentiation of bone marrow derived stromal (BMS) cells by interacting with α9β1 integrin receptors on the cell surface. The BMP peptide corresponding to amino acid residues 73-92 of knuckle epitope of the bone morphogenetic protein enhances osteogenic differentiation and mineralization of BMS cells. We hypothesized that orthogonal grafting of the three RGD, OPD, and BMP peptides to an inert matrix would induce adhesion, vasculogenic and osteogenic differentiation of BMS cells, leading to vascularized osteogenesis. Scaffolds grafted with the three peptides showed higher cell spreading and adhesion, higher extent of mineralization and expression of osteogenic markers, and higher expression of vasculogenic markers, compared to scaffolds not grafted with all three peptides. Results suggest that the RGD, OPD, and BMP peptides provide a favorable microenvironment for concurrent osteogenic and vasculogenic differentiation of progenitor marrow derived cells.

Biography

Esmaiel Jabbari completed his PhD in 1993 from Purdue University and postdoctoral studies from Monsanto Corp., Rice University, and Mayo Clinic. He is the Director of Biomimetic Materials and Tissue Engineering Laboratory and Associate Professor of Chemical and Biomedical Engineering at University of South Carolina. He received the Berton Rahn Award in Orthopedic Research from the AO Foundation in 2012 and the Stephen Milam Award in Maxillofacial Research from the Oral and Maxillofacial Surgery Foundation in 2008. He has published >130 peer-reviewed papers, edited a book, and authored 10 book chapters and presented >180 lectures at international conferences.

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