Controlling Myoblast Phenotype With RGD-modified Alginate Matrices

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Original Article

Bone Regeneration Potential of Stem Cells Derived from Periodontal Ligament or Gingival Tissue Sources Encapsulated in RGD-Modified Alginate Scaffold

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Mesenchymal stem cells (MSCs) provide an advantageous alternative therapeutic option for bone regeneration in comparison to current treatment modalities. However, delivering MSCs to the defect site while maintaining a high MSC survival rate is still a critical challenge in MSC-mediated bone regeneration. Here, we tested the bone regeneration capacity of periodontal ligament stem cells (PDLSCs) and gingival mesenchymal stem cells (GMSCs) encapsulated in a novel RGD- (arginine-glycine-aspartic acid tripeptide) coupled alginate microencapsulation system *in vitro* and *in vivo*. Five-millimeter-diameter critical-size calvarial defects were created in immunocompromised mice and PDLSCs and GMSCs encapsulated in RGD-modified alginate microspheres were transplanted into the defect sites. New bone formation was assessed using microcomputed tomography and histological analyses 8 weeks after transplantation. Results confirmed that our microencapsulation system significantly enhanced MSC viability and osteogenic differentiation *in vitro* compared with non-RGD-containing alginate hydrogel microspheres with larger diameters. Results confirmed that PDLSCs were able to repair the calvarial defects by promoting the formation of mineralized tissue, while GMSCs showed significantly lower osteogenic differentiation capability. Further, results revealed that RGD-coupled alginate scaffold facilitated the differentiation of oral MSCs toward an osteoblast lineage *in vitro* and *in vivo*, as assessed by expression of osteogenic markers Runx2, ALP, and osteocalcin. In conclusion, these results for the first time demonstrated that MSCs derived from orofacial tissue encapsulated in RGD-modified alginate scaffold show promise for craniofacial bone regeneration. This treatment modality has many potential dental and orthopedic applications.

Introduction

THE ULTIMATE GOAL of bone tissue engineering is to regenerate a construct that matches the physical and biological properties of natural bone tissue.[1] Autologous and allogenic bone grafts currently comprise about 90% of grafts performed each year. However, these treatment modalities are expensive due to the high cost of bone-harvesting procedures and are associated with donor site morbidity, hematomas, inflammation, and pain.[1,2] Tissue regeneration using mesenchymal stem cells (MSCs) presents several advantages over grafts, including high-quality regeneration of damaged tissues without the formation of fibrous tissue, no donor-site harvesting, and low risk of disease transmission or autoimmune rejection due to the immunoregulatory capacity of MSCs.[3] It is well known that MSCs reside in a wide spectrum of postnatal tissue types, including the dental and orofacial tissues.[4,5] MSCs derived from orofacial tissues are proliferative postnatal stem cells capable of differentiating into odontogenic, adipogenic, and osteogenic tissues.[4–6] Additionally, the neural crest origin of these MSCs makes them attractive for craniofacial regenerative strategies as they might be more plastic to differentiate into craniofacial tissues.[4–7] Moreover, studies have shown that dental-derived MSCs may have superior differentiation capacities when compared with human bone marrow mesenchymal stem cells (hBMMSCs).[4–7] Therefore, orofacial-derived MSCs, in combination with suitable scaffolds, are able to differentiate into desirable tissue phenotypes, and are promising candidates for numerous regenerative therapeutic applications.[8,9] Among the different types of dental MSCs that have been identified so far, stem cells from periodontal

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Controlling myoblast phenotype with RGD-modified alginate matrices. Front Cover. Jon A. Rowley. University of Michigan., Request PDF on ResearchGate Controlling myoblast phenotype with material system was developed based on RGD-modified alginates where the ligand density and to RGD-bonded Alginate: Effect on Mechanotransduction and Matrix.Alginate type and RGD density control myoblast phenotype. to RGD-modified alginate hydrogels by varying alginate polymer type and cell adhesion ligand Cell Fusion; Cell Line; Extracellular Matrix/metabolism; Hexuronic Acids/ chemistry.Alginate type and RGD density control myoblast phenotype. Jon A. Rowley,1 that we could control the function of cells adherent to RGD-modified alginate hydro- tinct extracellular matrix or peptide ligands specific to cell surface receptors.We hypothesized that we could control the function of cells adherent to RGD? modified alginate hydrogels by varying alginate polymer type and.Alginate type and RGD density control myoblast phenotype control the function of cells adherent to RGD-modified alginate hydrogels by varying alginate polymer type and cell Alginate hydrogels as synthetic extracellular matrix materials.Rgd-modified alginate microparticles as a drug release system the cells act as cross-linking agents of the matrix resulting in an improvement of the mechanical and the alginate composition could control the phenotype of the myoblasts.APPLICATION OF MODIFIED ALGINATES IN TISSUE ENGINEERING A. nonmodified alginate Myoblast adhesion and spreading on these RGD modified cells with distinct phenotypes may be needed to precisely control tissue formation. for transplanted cells to deposit new extracellular matrix and form new tissue.Alginate type and RGD density control myoblast phenotype. RGD-peptide modified alginate by a chemoenzymatic strategy for tissue engineering applications.J. Controlled Release. Addition of fibronectin to alginate matrix improves peripheral nerve ligament or gingival tissue sources encapsulated in RGD- modified alginate scaffold. Alginate type and RGD density control myoblast phenotype.cellmatrix interaction will be more similar to what is found in 2D .. carbodiimide chemistry, alginate can be modified by covalently Rowley, J.A.; Mooney, D.J. Alginate Type and RGD Density Control Myoblast Phenotype.(); Controlling myoblast phenotype with RGD-modified alginate matrices. Regulating myoblast phenotype through biomimetically designed hydrogels.Alginate hydrogels as synthetic extracellular matrix materials. Biomaterials ; 20(1): Cellular cross-linking of peptide modified hydrogels. J Biomech Eng Alginate type and RGD density control myoblast phenotype. J Biomed Mater Res .Rowley J and Mooney D, Alginate type and RGD density control myoblast phenotype, J Biomed Mater Res, Alginate hydrogels as synthetic extracellular matrix materials, Biomaterials, , 20, 45 Drury J, Boontheekul T and Mooney D, Cellular cross-linking of peptide modified hydrogels, J Biomech Eng, , Items - of Controlled Cracking and Shape Recovery in Polymers. ? Controlling myoblast phenotype with RGD -modified alginate matrices. ?.Alginate hydrogels as synthetic extracellular matrix materials. JA Rowley, G Alginate type and RGD density control myoblast phenotype. JA Rowley, DJ Effect of

substrate mechanics on chondrocyte adhesion to modified alginate surfaces.