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The effect of scaffold topography on behavior of dental pulp stem cells

Deniz Yucel[1,3], Hazal Gezmis[2], Secil Demir[2], Gamze Torun Kose[2,3], Nesrin Hasirci[3] and Vasif Hasirci[3]
[1]Acibadem University, Turkey
[2]Yeditepe University, Turkey
[3]Middle East Technical University, Turkey

Statement of the Problem: Tissue engineering aims to restore the damaged tissues or organs that are incapable of functioning properly. It involves scaffolds seeded with preferably the patient's own cells like mesenchymal stem cells (MSCs). For guided tissues, like nerve and bone, incorporation of guidance platforms into scaffold designs are known to enhance the regeneration environment. The aligned topography creates a permissive milieu for cell attachment, growth, cytoskeletal organization, guidance and even differentiation. The purpose of this study was to investigate the effect of scaffold topography on behavior of dental pulp stem cells, such as their attachment, proliferation and orientation.

Methodology: Random and aligned fibrous mats of polymer blend were fabricated by electrospinning. Human MSCs were isolated from dental pulp tissue. MSCs were seeded and cultured on biodegradable fibrous mats. Proliferation of cells on electrospun mats was studied using MTS. The cytoskeletal and nuclear orientation of the cells on scaffolds were investigated by confocal microscopy after FITC-Phallodin and DAPI staining for cytoskeleton and nucleus.

Findings: Random and aligned electrospun fibers without beads were obtained under optimized conditions. MTS results revealed that MSCs were able to grow and increase in number on both random and aligned fibers. Confocal microscopy results demonstrated that MSCs responded to the topography of scaffolds. MSCs on aligned electrospun mats were well oriented along the axis of the fiber while the cells on the randomly organized fibers appeared to spread randomly in every direction.

Conclusion & Significance: In the present study, guided tissue engineering approach with MSCs aligned on the highly oriented mats showed that it could serve as a guiding substrate for structural and functional regeneration for oriented tissue injuries.

Biography

Deniz Yucel has expertise in the field of Biomaterials and Tissue Engineering, 2D and 3D polymeric material design, stem cells (mesenchymal stem cells from various sources and neural stem cells), construction of biosensors, and enzyme/protein immobilization on polymeric materials. She received Best PhD Thesis Award in 2010 from Middle East Technical University for her PhD thesis titled, "Stem cell based nerve tissue engineering on guided constructs". During her PhD, she worked on mesenchymal stem cells and microfluidic systems for one year at Massachusetts General Hospital (MGH) - Harvard Medical School and at Tufts University. She is currently working on stem cells, studying their behavior on different scaffolds, and mainly on tissue engineering applications for various tissues like nerve, bone, tendon, and blood vessel.

deniz.yucel@acibadem.edu.tr