Abstract

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Decellularized articular cartilage microparticles for expansion of mesenchymal stem cells

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Abstract

The objective of this work was to develop a 3D microcarrier-based cell culture system that recreates the zonal structure of articular cartilage and can be implanted directly in an articular cartilage defect. To achieve the objective, fetal or adult bovine articular cartilage was decellularized and grinded to form cartilage microparticles (CMPs) as three-dimensional substrates for expansion and delivery of human mesenchymal stem cells (MSCs). MSCs were expanded on fetal or adult CMPs in suspension culture to form fCMP-MSCs or aCMP-MSCs, respectively. The MSCs cultured on fetal or adult CMPs retained the expression of MSC markers. The MSCs, without detachment from CMPs, were used to form injectable hydrogels or implantable cells sheets for delivery to the site of articular cartilage defect. For the injectable hydrogel, adult or fetal CMPMSCs were suspended in alginate hydrogel, injected in a mold, crosslinked with calcium chloride, and cultured in chondrogenic medium. For the implantable cell sheet, CMP-MSCs were suspended in culture medium, injected in a mold, allowed to settle gravitationally on the mold's bottom surface, and incubated in chondrogenic medium for 48 h to form a monolayer cell sheet. The previous steps were repeated to form a bilayer cell sheet consisting of fetal CMP-MSCs on top of adult CMP-MSCs. The injectable or implantable CMPMSCs constructs were characterized with respect to cellularity, expression of chondrogenic markers, and compressive modulus. The injectable CMP-MSCs hydrogels (fetal or adult) had significantly higher expression of chondrogenic markers and compressive modulus after four weeks incubation in chondrogenic medium compared to MSCs directly encapsulated in alginate hydrogel; implantable CMP-MSCs cell sheets had significantly higher expression of chondrogenic markers and compressive modulus compared to MSCs in the pellet culture. The implantable approach is potentially useful for creating multilayer cellular constructs by sequential settling of suspended CMP-MSCs in the medium to mimic the stratified structure of articular cartilage.

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Biography

Azadeh Sepahvandi has a Ph.D. in Biomedical Engineering and two postdocs in Biomechanics. She has 7+ years of extensive exposure to Biomaterials, a number of publications in Tissue regeneration and a worthwhile US patent in Retina Tissue Engineering. She is an instructor at the University of South Carolina

