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Capacity of Mesenchymal Stem Cells to Remodel a Biological Scaffold

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Objectives:

Successful tissue-engineering of a heart valve relies upon the capability of cells to remodel the supporting scaffold. The aim of this study was to assess the ability of mesenchymal stem cells (MSCs) to express remodelling enzymes after mechanical conditioning in a bioreactor.

Method:

Porcine collagen type I/III scaffolds (Chondro-Gide®) were coated with or without human fibronectin, seeded with human bone marrow htert MSCs, maintained under rotary conditions for 2 days, then conditioned in a bioreactor for 14 days. Cell phenotype, matrix metalloproteinases (MMP) and extracellular matrix were determined by immunocytochemistry. Cell viability was assessed using the MTS assay.

Results:

During rotary seeding, uncoated scaffold cell numbers increased by 30.86% while under mechanical conditioning cell number increased by a further 180.1% ($p < 0.005$; $n = 3$). Fibronectin coating showed no significant difference in cell number. Cells in both groups expressed smooth muscle alpha-actin, vimentin, CD29 and CD44. Smooth muscle myosin heavy chain, desmin and CD31 were not expressed. Glycosaminoglycans and proteoglycans increased after mechanical conditioning. The MMPs (-1,-3,-8,-13,-14) were similarly expressed in both groups while neither MMP-2 nor MMP-9 were detected. HSP47 expression only increased on the fibronectin coated scaffolds after mechanical conditioning.

Conclusions:

The ability of MSCs to populate, proliferate and remodel biological scaffolds under dynamic conditions are important factors to consider when tissue-engineering a heart valve.