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New marine collagen source induces high level of collagen type II synthesis in chondrocytes but not in mesenchymal stem cells
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The extracellular microenvironment plays a significant role in controlling cellular behaviour. Identification of appropriate biomaterials that support cellular attachment, proliferation and most importantly lineage-specific differentiation is critical for tissue engineering. Collagens exert important functions as cellular microenvironment and therefore make them ideally suited to use as biomaterial for tissue engineering (TE).

Here we designed collagen scaffolds from marine sources for cartilage TE. Since mesenchymal stem cells (MSCs) have multipotent capabilities including differentiation towards the chondrocytic lineage and MSCs have been used successfully in animal models to regenerate articular cartilage, we tested the MSCs concerning their cartilage-forming ability in marine collagen scaffolds.

Using adult mesenchymal stem cells from human bone marrow biopsies analyses show low cell attachment, low new extracellular matrix deposition as well as low differentiation capacity towards the chondrocytic lineage implying this as an unsuitable way for cartilage TE. However, primary adult chondrocytes seems to be a suitable cell source for engineering hyaline-like cartilage. Qualitative analyses of these bioscaffolds show chondrocyte cell adhesion to the matrix, cell proliferation as well as new matrix deposition. Based on (immuno)histological analyses this newly synthesized matrix consists of proteoglycans and collagens - the major constituents of hyaline, articular cartilage. Quantitative analyses on protein level show a collagen ratio of the chondrocyte specific marker collagen type II to the dedifferentiation marker of chondrocytes, collagen type I, of up to 50:1. From this, the in vitro engineered marine bioscaffold resembles to a hyaline-like cartilage with a mechanically functional collagen type II network.

Since in vivo cartilage damage often ends in a fibrocartilagenous, collagen type I containing matrix which is unable to withstand the demands of the mechanical environment of articular joints, the marine scaffolds may show promising results for the functional repair of articular defects using chondrocytes but not MSCs. Moreover, the new collagen source is a good alternative to the widely used bovine collagen which is associated with higher risks of BSE and TSE.