Hydrogel For Mesenchymal Stem Cell-Based Cartilage Tissue Engineering

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The repair of articular cartilage defects remains a significant challenge in orthopedic medicine, especially with stem cell-based approach. Hydrogels, three dimensional (3D) polymer networks that swollen in water, have been shown to promote the chondrogenic phenotype by encapsulated cells. Using hydrogels, cartilage tissue has been engineered in vitro with similar mechanical properties to native cartilage, and several hydrogels have been developed and used in clinics for autologous chondrocyte implantation procedures. A number hydrogels have been shown to support mesenchymal stem cell (MSC) chondrogenesis, generating cartilage-like ECM with considerable cartilaginous matrix. However, comparative analyses of the biochemical and mechanical properties of the regenerated neocartilage from donor-matched MSCs and chondrocytes under identical culture conditions, have consistently underscored the inferior functional properties of MSC-based constructs. Differences in developmental status of MSCs and the terminally differentiated mature chondrocytes, especially the MSC requisition to undergo mesenchymal pre-cartilage condensation, suggest a need to engineer appropriate hydrogel based on cell type. In this presentation, we present studies that demonstrate that MSCs and culture-expanded chondrocytes favour differential microenvironmental niches. For robust MSC chondrogenic differentiation, providing matrix environments that are amenable to cell-cell interactions are essential. The studies emphasizes the importance of designing biomaterials that meet cell type-specific requirements, in adopting chondrocyte or MSC-based approaches for regenerating hyaline, articular cartilage.