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Chondrogenic properties of collagen type XI, a component of cartilage extracellular matrix

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ABSTRACT

Cartilage extracellular matrix (ECM) has been used for promoting tissue engineering. However, the exact effects of ECM on chondrogenesis and the acting mechanisms are not well understood. In this study, we investigated the chondrogenic effects of cartilage ECM on human mesenchymal stem cells (MSCs) and identified the contributing molecular components. To this end, a preparation of articular cartilage ECM was supplemented to pellets of chondrogenically differentiating MSCs, pellets of human chondrocytes, and bovine articular cartilage explants to evaluate the effects on cell proliferation and the production of cartilaginous matrix. Selective enzymatic digestion and screening of ECM components were conducted to identify matrix molecules with chondrogenic properties. Cartilage ECM promoted MSC proliferation, production of cartilaginous matrix, and maturity of chondrogenic differentiation, and inhibited the hypertrophic differentiation of MSC-derived chondrocytes. Selective digestion of ECM components revealed a contributory role of collagens in promoting chondrogenesis. The screening of various collagen subtypes revealed strong chondrogenic effect of collagen type XI. Finally, collagen XI was found to promote production and inhibit degradation of cartilage matrix in human articular chondrocyte pellets and bovine articular cartilage explants. Our results indicate that cartilage ECM promotes chondrogenesis and inhibits hypertrophic differentiation in MSCs. Collagen type XI is the ECM component that has the strongest effects on enhancing the production and inhibiting the degradation of cartilage matrix.

Keywords

Cartilage extracellular matrix; human mesenchymal stem cells; collagen type XI; chondrogenesis; cartilage matrix degradation