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Abstracts

Cartilage proteoglycans: structure and function

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Cartilage is a load bearing elastic tissue composed of a gel-like matrix containing chondrocytes (cartilage cells), collagen fibrils, proteoglycans, ions, water molecules, etc. In healthy cartilage, collagen (primarily type II) amounts to about 15 - 20% and proteoglycans 4 - 7% of the wet weight. Collagen provides a mesh in which highly charged proteoglycans and their assemblies are enmeshed. A comprehensive understanding of the osmotic and mechanical properties of cartilage is necessary to evaluate the function of this tissue in health and disease.

Cartilage damage is primarily caused by wear and tear. Arthritis develops when the tissue begins to break down. Osteoarthritis is a nearly universal presentation of the normal aging process in which repetitive use of joints results in cartilage erosion. Most adults above age 60 have osteoarthritis to some degree. The behavior of cartilage is governed by a complex interplay among mechanical, biochemical and cellular forces. A better understanding of the physical-chemical interactions of cartilage extracellular matrix components is critically important for tissue engineering of cartilage.

Our objective is to determine the structure and physical properties of the macromolecular constituents of cartilage extracellular matrix at different hierarchical levels (aggrecan, hyaluronic acid, aggrecan-hyaluronic acid complex, collagen). Non-invasive techniques, such as small angle neutron scattering, neutron spin echo and dynamic light scattering are used to probe the properties of solutions at different length and time scales. The scattering measurements are complemented by nanoindentation measurements using atomic force microscopy and osmotic pressure observations, which provide information on the thermodynamic properties of the systems.