Osmotic forces in cartilaginous tissues

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Cartilaginous tissues are charged porous media saturated with a fluid of opposite charge. As a result of this, the stess in the tissue depends on the local ionic concentration, which in turn depends on boundary conditions, water content ionisation and external load. Different models have been proposed for the relationship between stress and ionic concentration. Donnan osmosis has been shown to be an oversimplified model to cover the full complexity of the cartilaginous behaviour. Chemical stress, chemical expansion stress and intrafibrillar water are a few mechanisms that have been proposed in the literature. The relative contribution of each of these mechanisms will be discussed on the basis of thermodynamic considerations and experiments. These experiments are performed not only on cartilaginous tissues but also on model materials mimicking some but not all of these mechanisms. Implications for mechanotransduction of the extracellular matrix will be presented.