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Abstracts

Longitudinal Mapping of the Mechanics of Mouse Knee Articular Cartilage

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Cartilage matrix is composed of a dense collagen mesh impregnated with the highly charged glycoprotein, aggrecan that is responsible for tissue osmotic swelling. The latter imparts the unique mechanical properties to the tissue, critical for the cushioning of bones at the joints. The relationship between osmotic and mechanical properties and composition is poorly understood and mapping of the related parameters through the tissue depth is complicated by a number of issues relating to the need to section the tissue in order to gain access. Tissue damage and roughness at the sectioned surface, matrix collapse due to osmotic pressure release and aggrecan diffusional loss at the section are some of those issues. Mechanical properties are usually measured by tissue indentation and data interpretation often poses its own challenges not least because of the natural inhomogeneity of the tissue. Here, we performed high-resolution (1um) elasticity mapping of the cartilage matrix of both newborn and adult mice. The indentations were performed on thin (~10um) cartilage sections that were cut parallel to the bone longitudinal axis. 5um microspheres were used as indentation probes and we applied large indentations to minimize the effects of surface roughness and geometric inhomogeneities. We developed a novel method to define the contact point on the collected indentation curves, and our model fitting protocol ensures that we are probing the bulk matrix properties and minimizing the effects of surface damage, tissue inhomogeneity and finite sample thickness. Our results show interesting variation of properties between different regions and between growing and adult cartilage. We also discuss correlating the mechanics with osmotic pressure profiles and with composition through the tissue depth.