Degeneration of articular cartilage as a result of small shear deformation

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ABSTRACT
De-structuring of the collagen network in articular cartilage is a part of the process that leads to osteoarthritis. Better understanding in the causes of de-structuring and in the mechanical behavior of articular cartilage is necessary to improve treatments for osteoarthritis. The first objective of this study was to find whether de-structuring of the collagen network can be caused by small shear deformations. The second objective was to find whether the amount of shear stress relaxation of articular cartilage is dependent on the magnitude of the shear deformation. Porcine osteochondral samples were subjected to shear strains of 6%, 9% and 12%. Picrosirius red and alcian blue stained sections of the samples were analysed. Other sections were analysed with the help of DIC microscopy. Small shear deformations were not found to be the cause of collagen network de-structuring. Shear stress relaxation in walking direction of articular cartilage is dependent on the magnitude of the shear deformation.

GRAPHICAL ABSTRACT

- Small shear deformations of articular cartilage were not found to induce damage to the collagen network.
- The mechanical behavior of articular cartilage regarding shear stress relaxation was elucidated by comparing the forces that were necessary to reach a certain shear strain at different moments in time.