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LETTER TO THE EDITOR

Effects of Glycation on Mechanical Properties of Articular Cartilage

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Diabetes alters connective tissues and the changes are at least in part due to an increase in glycation.[1] Although there are relatively a great number of research related to the effects of glycation on biochemical changes in articular cartilage, effects of glycation on mechanical properties of articular cartilage are largely unknown. In this study, we focused on the effects of glycation on the biomechanical properties of cartilage, eliminating all other complicated changes.

Fresh equine metacarpophalangeal joints were collected from a local abattoir (Potters, Taunton, UK). Full-thickness cartilage plugs 10 mm in diameter and approximately 1 mm thick were then excised from dorsal region. Cartilage samples were washed overnight at 10°C in 5 mM sodium phosphate buffer containing 0.9% sodium chloride. Glycated cartilage samples were prepared by incubating samples in a 2.8 M glucose solution (500 mg/mL in distilled water) containing 3 mM sodium azide at 37°C for 14 days. Control samples were soaked with phosphate buffered saline solution for the same period as the experimental group.[1] Thirteen samples, including six controls and seven experimental diabetes samples, were analyzed in total. The experimental details may be reviewed in previous papers.[1,2] One-way analysis of variance was used for statistical analysis. A p value less than 0.05 was considered statistically significant.

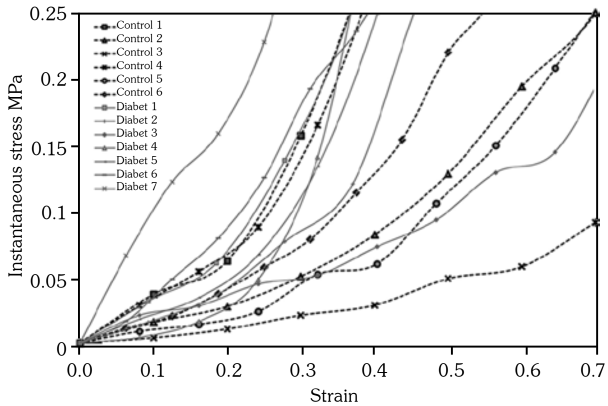

Figure 1. Representative instantaneous stress-strain curves. MPa: Megapascal.

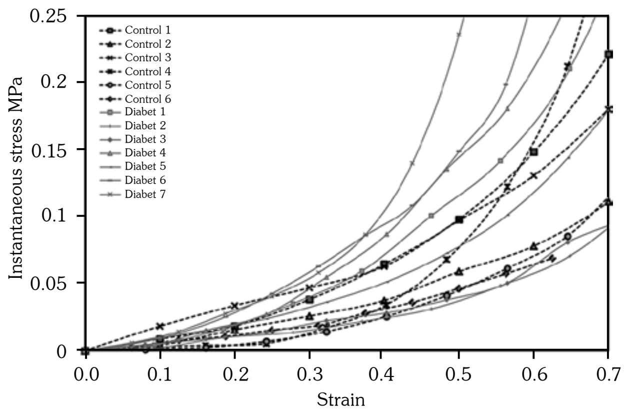

Figure 2. Representative equilibrium stress-strain curves. MPa: Megapascal.

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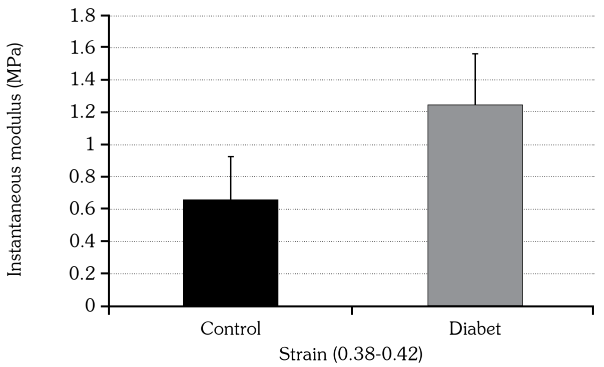

Figure 3. Instantaneous modulus graph of control and experimental groups. MPa: Megapascal.

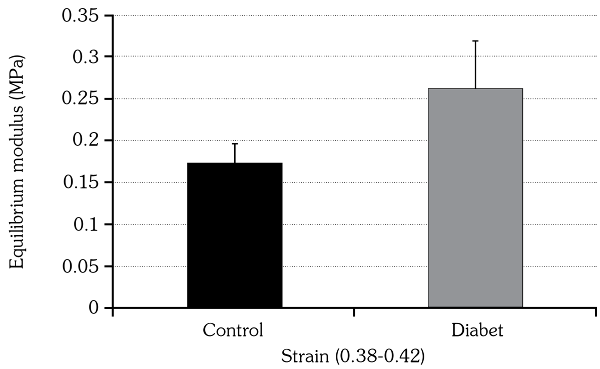

Figure 4. Equilibrium modulus graph of control and experimental groups. MPa: Megapascal.

It was obvious that slopes of diabetes curved higher than slopes of control curves, which meant that experimental group had more stiffness than the control group (Figures 1 and 2). This result indicates that diabetes induced toughness and brittleness of cartilage.

Our instantaneous stress-strain curves from the control and experimental groups resulted in the highest stress values of 0.16 MPa and 0.33 MPa, respectively, for 0.3 strains, with clearly lower control curve slopes than that of diabetes curves, which account for higher stiffness values in the exposed cartilage (Figure 1). Differences among groups were statistically insignificant (p=0.19) (Figure 3).

Likewise, with the highest stress values of 0.047 MPa and 0.058 MPa in the equilibrium stress-strain graph for control and experimental groups, respectively, increased stiffness was observed in the experimental group (Figure 2). However, differences among groups were statistically insignificant (p=0.2) (Figure 4).

Glycation results in increased crosslinking and crosslinks play a valuable role in the stiffness of the collagen fibrils. Incubation of articular cartilage with glucose increases cartilage stiffness.[3-6] Ribose treatment induced increased tensile strength and stiffness, and decreased failure strain in bovine cartilage samples. In articular cartilage, these changes suggest that there are some specific biomechanical results of the naturally occurring age-associated augmentation in advanced glycation end product (AGE) levels.[7] Augmented concentration of glucose in the diabetic cartilage would lead to the deleterious result.[8] Similar results were obtained in this study.

In conclusion, increasing cartilage AGEs crosslinking by *in vitro* incubation with glucose resulted in increased stiffness of cartilage.

Declaration of conflicting interests

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