Reviewer’s report

Title: Viscoelastic properties of bovine knee joint articular cartilage: dependency on thickness and loading frequency.

Version: 3 Date: 20 January 2014

Reviewer: X. Lucas Lu

Reviewer’s report:

Review for BMC Musculoskeletal Disorders

Summary
The authors are responsive to the first review and addressed most of the concerns raised by this reviewer. There are a few points that should be further clarified.

General Comments

Original Comments: DMA was used to perform a frequency sweep on cartilage tissue, and two preload conditions were applied before testing with a 60s rest period. It usually takes hours for cartilage tissue to fully recover from a 10% thickness deformation. Thus the length of rest period could significantly affect the outcome of following tests.

Answer: The reviewer’s paradigm ignores the need for precycling in cartilage and its role in knee dynamics, also we have addressed this point in previous publications. Further reference is now made to the two studies in which the procedure used is validated (page 6, lines 4).

The answer did not fully address the original question. How long is the precycling? The author can show the force-time curve or displacement-time curve to see whether the dynamic loading reached final steady state (the average force/deformation is constant).

Original Comments: The heel-strike can happen in less than 10 ms, but the impact loading is different with a 100 Hz dynamic loading. Under continuous high frequency loading, cartilage tissue can barely follow the loading platen. This is the famous “lift-over” problem in cartilage biomechanics. This problem is usually cautiously avoided by monitoring the force response curve of loading device. It is important for the author to demonstrate the actual force response curve and displacement curve over time during dynamic test. Although a force-control test was performed in this study, it is questionable whether the tissue can follow an 88 Hz vibration in complete sinusoidal curve.

Answer # Our study demonstrates how frequency alone can alter mechanical properties of cartilage. The feasibility of the method used has been previously
published. Further reference is now made to the two studies in which the procedure used is validated (page 6, line 4).

The question is whether there is lift-over problem during high-frequency cyclic test.

Question: The results demonstrated different moduli for cartilage at different locations. However, is this difference correlated with the thickness of tissue, or correlated with the strength and ultrastructure of solid matrix in cartilage? Without answering this question, the clinical meaning of this study is limited. It is widely accepted that intrinsic mechanical properties and ultrastructure of cartilage are regional-dependent in knee joint. However, current testing strategy showed that the properties are highly correlated with tissue thickness. Is the obtained result in this study the true intrinsic property of cartilage tissue? Or is it correlated with the geometry of the tissue?

Answer: We have demonstrated that dynamic mechanical properties of cartilage are significantly correlated with its thickness. This is consistent with studies on static loading [11] and studies that have investigated changes to knee cartilage ultrastructure and thickness [14]. This is now clarified in the text (page 12, lines 15-18).

The mechanical modulus of a material should not be related to its geometric shape. Otherwise it cannot be called the modulus of material. It is not a surprise the “modulus” reported in this study is correlated the thickness, but it is extremely important to clarify the possible reasons.

Question: What is geometry of tested cartilage-bone block? The indenter has a diameter of 5.2mm. What is the size of cartilage surface?

Answer: The reviewer has answered his own question: the indenter in contact with cartilage had a diameter of 5.2 mm. Further reference is now made to the two studies in which the procedure used is validated (page 6, lines 4).

The indenter in contact with cartilage had a diameter of 5.2mm. The size of the indenter fixed on DMA and the cartilage sample are both 5.2mm in diameter? Hopefully this is not the case.

Level of interest: An article whose findings are important to those with closely related research interests

Quality of written English: Acceptable

Statistical review: No, the manuscript does not need to be seen by a statistician.

Declaration of competing interests:

I declare that I have no competing interests.