Reviewer’s report

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

Version: 3 Date: 21 January 2014

Reviewer: Deva Chan

Reviewer’s report:

Summary

Despite minor changes made by the authors, the significance of this paper remain hampered by the use of stiffness, which is inherently a geometry-dependent measure, rather than modulus to convey the dynamic properties of cartilage. If thicker cartilage is indeed structurally weaker than thinner cartilage, this difference should manifest itself in the intrinsic properties (i.e. modulus) of the cartilage. Removal of the inherent dependence on geometry of stiffness measurements by using geometry-independent measures such as loss and storage modulus would only strengthen the author’s conclusions that thick cartilage is inherently weaker – that is, if a similar dependency on thickness can be shown in dynamic modulus.

A. Major Compulsory Revisions

1) The authors have not addressed the concern that, by measuring and presenting only stiffness (mechanical behavior), rather than modulus (intrinsic property), they are biasing their results in such a way as to guarantee a dependence on thickness. A thicker specimen, given the exact same intrinsic material properties as a thinner specimen, will indeed be less stiff - by definition (which is stated in the manuscript, page 3, lines 19-24). It is therefore no surprise and not novel that stiffness would be dependent on the thickness of cartilage because the stiffness of any material is dependent on the thickness of the tested sample. As stated in the original comments, in order for these results and conclusions to be meaningful, the authors need to report moduli instead of stiffness (as they had done in Ref 4) in order to properly assess the relationship between the dynamic properties and cartilage of varying thickness.

2) Much like the term “modulus,” the terms “property” or “properties” should not be used interchangeably with “stiffness,” which is measure of “mechanical behaviour under loading” and also dependent on sample geometry. This was pointed out in the previous Major Revisions (1) and not addressed.

3) In the ‘Methods’ and also the ‘Discussion,’ the authors still have not explained why cartilage thickness was not measured non-destructively prior to testing. The previous study that was cited (Ref 18) provides no such explanation. So the questions remain: Is there a control to ensure that the cyclic loading did not affect the cartilage thickness? Was enough time allowed for the viscoelastic tissue to
recover from loading before measuring the thickness of the cartilage? Considering that a major conclusion of this study relates directly to thickness, the methods by which thickness are measured must be fully justified.

4) The question of the test specimen geometry (Minor Essential Revisions, 4) was not addressed in the revisions. The authors cite two previous studies rather than report the size. However, the "typical" thickness, and not cartilage surface area, is described as 20 mm in Ref 4, and the dimensions given in Ref 18 are 45 mm deep, with 40 mm x 40 mm in area. Because these references conflict, it is not unreasonable to expect that the specimen size be explicitly reported in this manuscript.

B. Minor Essential Revisions

1) This comment (Minor, 11) was not addressed in the revisions. The ‘Discussion’ of Reference 28 should be edited to distinguish the actual results of the study from the statement that bone joint area increases in the initial stages of OA. In that reference, baseline tibial plateau bone area is associated with the loss of cartilage after 2 years in their cohort and bone area is not reported for other time points other than baseline. The result shows that a larger bone area is correlated to greater cartilage loss but cannot be used to justify the statement that bone area increases during OA.

C. Discretionary Revisions

**Level of interest:** An article of limited interest

**Quality of written English:** Needs some language corrections before being published

**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.