Reviewer's report

Title: The Optimal Slice Thickness Of MRI Scans For The Assessment Of Knee Cartilage Volume For Cross-Sectional And Longitudinal Studies

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Reviewer: Stephen Gandy

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General

This paper addresses the influence of MRI slice thickness on the ability to measure medial tibial, lateral tibial and patellar cartilage volumes in two patient cohorts. The authors conclude that it is possible to use thicker MRI slices (3mm) without introducing any significant additional measurement error, and thus reduce both the image acquisition time and the post-processing time.

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Major Compulsory Revisions (that the author must respond to before a decision on publication can be reached)

1. Definition Of Slice Thickness
   Volume measurements for the ‘3mm’, ‘4.5mm’ and ‘6mm’ image slices have actually been extracted from the original 1.5mm slice thickness acquisitions. These images do not therefore contain the cartilage partial volume errors that real 3mm, 4.5mm or 6mm slices would demonstrate. Analysis of one in every two, three or four thin image slices is fundamentally not the same as analysis of one image slice that is two, three or four times thicker than the original. If the described methods are implemented, then post-processing time could well be reduced substantially (e.g. by analysing every two, three or four slices – as described), but a reduction in the scan time (presumably by using thicker slices) really cannot be justified from these data. Minimisation of partial volume errors is particularly important for patients with knee osteoarthritis, since the disease is often focal in the cartilage and could easily be missed (on a per patient basis) if slices are either too thick or are overlooked.

2. Lack Of Femoral Cartilage Volumes
   I was surprised to read that femoral cartilage volumes were not analysed as part of this study. Femoral cartilage is centrally involved in both patellofemoral and tibiofemoral joint osteoarthritis, and should not be ignored. From personal experience I am aware that the partial volumes that arise when segmenting sagittal femoral cartilage images are rather acute (much more so than for the other compartments included in this report). This is particularly evident when slices close to the inner and outer edges of the medial and lateral condyles are considered. It would be interesting and important to see what effect the authors’ selective slice analysis technique would have on cross-sectional and longitudinal femoral cartilage volume measurements, and also what effect true 3mm, 4.5mm and 6mm slices would have on the measured volumes in all compartments. If these data are available, or will soon be available, then they should be included.

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Minor Essential Revisions (such as missing labels on figures, or the wrong use of a term, which the author can be trusted to correct)

1. Quality Assurance Validation Of MRI Slice Thickness
Since slice thickness is the main focus of this paper, have the authors performed any Quality Assurance on their scanner to verify that the slice thickness that they have used is actually 1.5mm? There is usually a fair degree of error associated with slice thickness measurements, with the values often being over-estimated (e.g. a sequence with an ‘apparent’ 1.5mm slice thickness may actually be delivering a slice thickness nearer to 2.0mm in practice). The true value of the slice thicknesses used in this paper would probably not affect the presented results significantly, but a mention of a Quality Assurance strategy would give readers added confidence in the reported data should they wish to undertake similar studies.

2. Difference In Lateral/Medial Tibial Cartilage Volumes In TASOAC v KCV Cohorts
It seems counter intuitive that the older TASOAC cohort with higher recorded ROA have larger lateral and medial tibial cartilage volumes than those younger patients in the KCV study with less ROA? Is there any reason for this? One might have expected this volume difference to be the other way around, bearing in mind the authors’ earlier publication documenting 5% loss of knee cartilage per annum in OA patients.

3. Potential Validity For Longitudinal Studies
One of the points raised in the discussion considers the potential importance of different observers and MRI machines being used to acquire and analyse MRI knee cartilage volume data for longitudinal studies. I was not completely clear whether all of the data for the patients in these two cohorts (TASOAC and KCV) had been acquired from the same Picker MRI scanner described in the methods? Is it possible that there might be some sort of error (random or systematic) that could explain the volume differences discussed in 4, above? It would be useful for this to be clarified more clearly in the manuscript.

4. List of References
The reference list has neglected some rather significant work in the field of MRI knee cartilage volume imaging. It is clear that the authors have published substantially in this area, but currently over 50% of the MRI knee cartilage volume references listed in this manuscript are ‘in house’. Significant contributions to this field have been published by other groups e.g Eckstein/Reiser et al from Munich, Germany, Peterfy/Genant et al from UCSF, USA, and Waterton et al from Manchester, UK. These publications have covered topics such as validation of MRI knee cartilage acquisition methods, slice orientations, volume analysis methodology, intra-/interobserver CoV analysis, longitudinal changes (daily, yearly, short term response to exercise etc). It would be beneficial to widen the scope of the references where possible to aid the interested reader.

5. Page 6 – final sentence of ‘Other Measurements’ paragraph – the total score of knee ROA could vary from 0-12. Further down in the Results section and in table 1, the total ROA score seems to be defined as having a maximum score of 9. This should be standardised, maximum either 9 or 12, or the difference in each scoring system explained more clearly.

6. Page 9 – the 9% discrepancy between cartilage volume and water displacement: - similar data have also been published by other groups, and should be included here.

Discretionary Revisions (which the author can choose to ignore)

Summary
Regretfully, it is my opinion that this paper should not be published as it stands. This is because the conclusion incorrectly recommends that MRI scan time (acquisition costs) can be reduced by using thicker slices, and also because important data for the femoral cartilage are not reported. However in recognition of the amount of work involved in undertaking a study such as this, the journal may wish to consider resubmission of this work from the authors at a later date following revision and addition of appropriate material.
What next?: Reject because scientifically unsound

Level of interest: An article of limited interest

Quality of written English: Acceptable

Statistical review: No