An assessment of MRI reproducibility for the purpose of radiotherapy treatment planning.

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ABSTRACT

Purpose: The introduction of MRI only radiotherapy planning, compared to using both MRI and CT can introduce uncertainties due to patient and system distortions and lack of electron density information, however it also has the potential to reduce uncertainties with the elimination of the need to register MRI and CT. This study aimed to assess the reproducibility of MRI compared to that of CT registered to MRI.

Materials & Methods:
Ten rectal, prostate and gynaecological cancer patients (thirty patients in total) were scanned on a Phillips Brilliance 16 slice Big Bore CT scanner and then on a Siemens 3T Skyra MRI scanner. Patient position for both scans was consistent with radiotherapy set-up position. A T2 weighted turbo spin echo MRI sequence was used for all patients with radiotherapy specific parameters to minimise distortions and artefacts such as high receiver bandwidth (> 400Hz/Px) and use of vendor supplied three-dimensional distortion correction. Following a small break when the patients were asked to get up from the MRI scanner couch and then get back on again, patients were rescanned again on the MRI scanner in the same position and identical image sequences. A series of anatomical landmarks including bones, soft tissue and vascular structures were contoured on all three datasets. The MRI scans were then each rigidly registered to the CT image and to each other. Dice similarity metrics and mean absolute surface distances were determined between contours.

Results:
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As seen in Figure 1 the DICE metric was consistently larger for the MRI to MRI registration (red) than the CT to MRI registration (blue) for all structures and all 3 clinical sites. The mean absolute surface distance showed similar results with the distances consistently smaller for MRI to MRI registration than CT to MRI registration.

**Conclusions:**
Uncertainties between MRI and MRI image fusion have been shown to be smaller than CT to MRI image fusion demonstrating a reduction in radiotherapy treatment planning uncertainties if the CT to MRI registration process can be removed as possible with MRI only planning.

![Figure 1](image-url)