order to overcome the limits of T1-weighted 4D MRI, we present a preliminary study to derive a virtual T1-weighted 4D MRI, based on T2-weighted 4D images and a T1-weighted breath-hold acquisition.

**Material and Methods:** Free-breathing, sagittal, dynamic multi-slice T2-weighted MRI series of the liver were acquired on a 1.5T scanner (Siemens Avanto) in five healthy volunteers with a balanced steady state free precession sequence (TrueFISP, 20 slices, 20 dynamics, 1.28x1.28x5 mm resolution, 150 msec per slice). Slices were then retrospectively sorted in 4D volumes according to an image-based method. A volumetric axial T1-weighted acquisition was also performed at breath-hold during inhalation (VIBE, 60 slices, 1.25x1.25x4mm resolution). The proposed method involved applying the motion field derived from the T2-weighted 4D MRI dataset to the T1-weighted breath-hold acquisition. Specifically, a rigid registration of the breath-hold acquisition was performed onto the T2-weighted series at the corresponding inhale phase. Then, we performed a deformable registration between each respiratory phase and the inhale phase of the T2-weighted 4D scan. The derived motion fields for all respiratory phases were then used to warp the T1-weighted breath hold acquisition (i.e. deriving the virtual T1-weighted 4D MRI).

**Results:** The performance of the rigid registration was evaluated by computing the distance of the organ profile between the registered T1-weighted breath-hold volume at the inhale phase and the T2-weighted 4D scan at the same respiratory phase in two region of interests (liver and kidney). The distance between the two volumes was below the maximum voxel size (i.e. 5mm). The derived virtual T1-weighted 4D MRI at exhale was able to compensate for the motion obtained from the T2-weighted 4D scan (Figure, A: T1-weighted and T2-weighted volumes; B: overlap of virtual T1-weighted at exhale (red) with T2-weighted at exhale (green) and virtual T1-weighted at exhale (red) with T2-weighted at inhale (green)). Both diaphragm and vessels resulted closer to the T2-weighted 4D MRI at the exhale phase than the inhale phase, with a residual distance in the liver profile measuring 2.1±1.5mm (uncompensated motion).

**Conclusion:** Our results provide preliminary demonstration of a well-contrasted virtual T1-weighted 4D MRI and the subsequent description of tumor motion and composition according to T1 and T2 weightings. Future work will be focused on the validation of the method relying on an MRI phantom, which can provide a ground truth T1-weighted 4D MRI.

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EP-1898 A workflow for automatic QA of contour propagation for adaptive radiotherapy
Results: There was a strong correlation between the consistency metrics and the true accuracy ($r = 0.85$ and $r = 0.70$ for DSC and DTA, respectively), indicating that the new method is suitable to automatically infer contour propagation accuracy. In addition, a simple threshold on the consistency metrics enabled accurate automatic identification of introduced errors (fig 1E).

Conclusion: The presented workflow enables the accuracy of a propagated contour to be tested automatically for any patient, and for errors to be identified. This method can be used as part of an online ART protocol, to automatically detect contour propagation issues that require manual review and contour editing.

EP-1899
Evaluation of SEMAC MRI metal artifact reduction for orthopaedic implants in radiotherapy planning
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Purpose or Objective: Many commonly used metallic orthopaedic implants cause artifacts in MR and CT images and are a serious challenge for obtaining high quality anatomical images for radiotherapy (RT) planning. We investigate the utility of SEMAC (Slice Encoding for Metal Artifact Correction [Ai et al. Invest Radiol 47: 267-76, 2012]) in patients with hip replacements and spine fixation devices, and consider the impact of metal artifacts on the registration of MR and CT images for RT planning.

Material and Methods: This study was approved by the Ethics Committee. MRI was undertaken on a 70 cm bore system (1.5T MAGNETOM Aera, Siemens) adapted with a home-built flat bed. SEMAC fast-spin-echo (FSE) pulse sequences were developed to approximate the coverage, image quality and contrast of the conventional FSE protocol (WARP works-in-progress software package, Siemens Healthcare). MR and CT images were registered using standard RT software (Pinnacle, Philips); conventional FSE and SEMAC FSE pulse sequences were compared on a purpose-built test object (spine fixation device suspended in gelatine) and on clinical examinations. Six patients with bilateral hip replacements and two patients with metallic fixation devices on the spine were scanned. For the spine fixation devices the visibility of the spinal canal was assessed. For the hip replacement patients, the internal surface of the pelvic girdle was scrutinised. Conventional and SEMAC FSE images were compared to detect relative geometrical distortion.

Results: The conventional FSE protocol shows extensive areas of signal loss and signal pile up around the spine fixation device test object. Signal loss volume was reduced from approximately $16.0 \pm 0.5$ cm$^3$ to $12.9 \pm 0.5$ cm$^3$ when the SEMAC FSE protocol was used. The two spine patients were shown to have metallic implants adjacent to the spine canal, which was partially affected by signal loss in three separate slices for conventional FSE protocols. Using the SEMAC FSE protocol, areas of signal loss and signal pile up are significantly reduced; the spinal canal is visible throughout the scanned volume (Figure 1). Geometrical distortion and signal loss were visible in all of 12 hip replacements scanned, but the metal artifacts do not reach the prostate, bladder and the seminal vesicles. In 8 of those hip replacements the signal loss extended to the internal surface of the acetabulum with conventional FSE protocols. Using SEMAC FSE techniques the signal loss is reduced and for only four of the hip replacements it was not possible to visualise the complete internal surface of the pelvic bones.

Conclusion: This work demonstrates improvement in geometric accuracy and reduction in signal loss around common metallic implants using SEMAC FSE sequences, with a positive impact on CT-MR registration. This technique will enable better contouring confidence in the location of target volumes and organs at risk which are close to metallic implants.

EP-1900
Geometric accuracy of MRI for stereotactic radiosurgery planning of Acoustic Neuromas at 3 Tesla
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Purpose or Objective: MR-CT co-registration is a mandatory requirement to accurately plan Stereotactic Radiosurgery (SRS) for Acoustic Neuromas (AN). MRI scans are subjected to susceptibility-related magnetic field inhomogeneity in the proximity to air spaces and this effect is enhanced at higher magnetic fields. We investigate the geometric distortion of anatomical MRI head images acquired at 3 Tesla (3T), and consider protocol requirements for SRS.