IEC Image Quality Phantom with spheres filled with different spheres/background activity ratios. An adaptive thresholding method based on signal/background ratio was used to delineate sphere volumes. The results of the phantom study were extended to clinical PET studies (25 patients with head and neck disease) obtaining the GTVs that were subsequently compared to the CT/GTV

Results: There is a linear relationship between the thresholds and sphere volumes up to 2.5 mL. For smaller volumes the thresholds increase exponentially. The thresholds do not depend on the acquisition time but depend on sphere volumes, signal/background ratio and smoothing filter. SUV is correctly quantified for volumes up to 2.5 mL while for smaller dimensions the SUV values are underestimated up to 80%. For all patients CT/GTVs were modified including PET information. CTV_PET overlaps the CTV_CT in almost all patients (CTV_overlap fraction is **0.996**) while PET significantly influences the GTV definition as it is confirmed by the high fraction of GTV_mismatch (**0.41**)

Conclusions: Lesion segmentation of PET images relying on an adaptive thresholding method may be useful for a correct tumour definition. However this method may provide unreliable results for volume less than 2.5 mL. The definition of GTV including PET information can significantly change the Radiotherapy treatment planning.

EP-1525

Positional reproducibility during Deep Inspiration Breath Hold for left breast radiotherapy patients

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Purpose/Objective: To determine the reproducibility of the heart location during Deep Inspiration Breath Hold (DIBH) for radiotherapy of left sided breast cancer patients.

Materials and Methods: A total of 5 left sided breast cancer patients were imaged for three fractions using a Philips Big Bore CT with a fast low dose axial 3D CT protocol. A body surface laser scanning system (C-rad Sentinel) produced the respiratory signal by detecting a point at the thorax of the patient through illumination of the patient skin by a scanned laser beam and extracting the room coordinates by optical triangulation. The detection point was located just cranially from the Xiphoideus process. The patients were guided to take a deep breath and hold it as visualized in a patient-specific gating window for 15 seconds followed by 15 seconds free breathing. This was repeated 12 times in order to simulate a typical time for treatment delivery for a static field breast treatment plan. For each fraction, four different DIBH sessions was imaged with five fast axial CT-images in a burst. The imaging frequency was two images per second which increase the chances to image the patient with the heart in different phases of the heart cycle. Each axial image was captured during 0.3 seconds. During each burst it was assumed that the position of the heart edge only is influenced by the intrinsic heart movement, i.e. the lung edge position, air pressure and mechanical stretching in the thorax were all assumed to be constant during this time interval. The internal position of the edge of the heart and thorax was determined by means of a geometrical construction aiming to yield the distance perpendicular to the axis of the opposing beam. The standard deviations of the heart and lung position were determined by analyzing the data.

Results: Four patient managed to have a gating window of 3 mm (±1.5 mm) and two (patient 3 and 4) needed 4 mm (±2 mm) gating window. The resulting standard deviations are presented in the table below where Sigma_Heart_Intra is the variation in heart edge position due to intrinsic heart motion, and Sigma_Heart_Inter is the variation in heart edge position due to different lung fillings. Sigma_Lung_Intra gives the real variation of the lung edge positions during the bursts and Sigma_Lung_Inter gives the standard deviation for position displacement between DIBH-sessions.

Pat	Sigma_Heart_Intra (mm)	Sigma_Heart_Inter (mm)	Sigma_Lung_Intra (mm)	Sigma_Lung_Inter (mm)
1	1.0	1.7	0.2	1.6
2	0.9	2.4	0.5	1.6
3	1.3	2.1	0.5	1.3
4	1.7	1.9	0.7	1.0
5	1.0	3.8	0.6	1.7

Conclusions In general, the reproducibility in heart edge position between DIBH´s is about ±4-8 mm (2 SD) and the variation in lung edge is about ±2-3 mm (2 SD). During each DIBH the variation it is about half that of the variation in between the DIPH sessions. The effect of breathing method (abdomen or thoracic inhalation) is under investigation in order to determine the use of two gating points.

EP-1526

Functional MRI for predicting metastatic spreading at the time of surgery after neoadjuvant radiotherapy

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Purpose/Objective: Neoadjuvant radiotherapy (NeoRT) improves tumor local control and tumor resection in many cancers. The timing between the end of the NeoRT and surgery is driven by the occurrence of side effects or the tumor downsizing. Some studies demonstrated that the timing of surgery and the RT schedule could influence tumor dissemination and subsequently patient overall survival. Our aim is to evaluate with functional MRI the impact of the radiation treatment on the tumor microenvironment and subsequently to determine the best timing to perform surgery for avoiding tumor spreading.

Materials and Methods: We used a model of NeoRT, murine mammary carcinoma 4T1 cells were implanted in the flank of BalbC mice. Seven days after cell injection, tumors were

irradiated with 2x5 Gy than we surgically removed this lesion 11 days after RT. Diffusion Weighted (DW) and Dynamic Contrast Enhancement (DCE) -MRI was performed every 2 days during 11 days between RT and surgery. Control group (i.e. non irradiated tumor bearing mice) was processed in parallel for MRI and surgery. We developed a homemade 'portacath (PAC)' specifically dedicated for mice and for repetitive i.v. gadolinium contrast agent injection. For each tumors we acquired 5 slices of 0.6 mm thickness and 0.3mm gap between each slices with an 'in plane voxel resolution' of 0.34 mm^2. We kept the same slices position for DCE and DW-MRI. For DW-MRI, we performed FSEMS (Fast Spin Echo MultiSlice) sequences, with 10 different B-value (form 20 to 1000) and B0, in the 3 main directions. With this amount of B-value, we performed IVIM (IntraVoxel Incoherent Motion) analysis, in the aim to obtain information on intravascular diffusion and subsequently tumor vessels perfusion. For DCE-MRI, we used FSEMS sequence for keeping the same 5 slices as with DW-MRI. After the T1 mapping, we performed DCE acquisition with a temporal resolution of 5.6 sec. After 10 repetitions, we injected 100 µl of gadopentetate dimeglumine (0.1 mmol/kg) in 5 sec. via the PAC and recorded the 190 following repetitions during 14 min. for the contrast enhancement and wash out. For both images, we performed analysis on the entire tumor volume and we obtained the mean tumor signal.

Results: We obtained very promising preliminary results showing good uniformity in the ADC (Attenuation Diffusion Coefficient). We succeeded to follow mice with imaging during the 11 days without major troubles. We observed less variability of the ADC signal during the 11 days in the irradiated tumors compared to the control. The signal to noise ratio was relatively poor for the diffusion sequence and the perfusion fraction.

Conclusions: For the first time, we demonstrate the feasibility of repetitive MRI functional imaging in a mice model of NeoRT. These results open perspectives for studying modifications of the tumor microenvironment induced by neoadjuvant RT. The techniques need to be improved and correlated to the tumor dissemination in function of the RT schedule and timing of surgery.

EP-1527

Early results from a clinical trial of visual feedback from dynamic optical surface sensing in lung cancer patients

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Purpose/Objective: Interim analysis of a clinical trial to test the tolerability and efficacy of the visual feedback of dynamic measurement of lung cancer patients' body surfaces in aiding motion management during radiotherapy

Materials and Methods: Christie Medical Physics and Engineering have previously developed a wide field, real-time optical surface measurement device for use during radiotherapy [1]. A pilot study, using the device to provide visual feedback to patients with the aim of helping them self-manage their intra-fraction motion was conducted in healthy volunteers and demonstrated improved control and reduced variability [2].

However, before the clinical potential of the device can be assessed, it is vital to know: (i) if the device can be tolerated and understood by often elderly patients who commonly present with severe co-morbidities, and (ii) if external control of intra-fraction motion correlates to reduced internal anatomical variability. We present an interim analysis of the first patients from a clinical study designed to answer these questions (Ethics committee ref. 14/NW/0037). Each lung cancer patient recruited to the study is asked to undertake 4 sessions in which they use the visual feedback device. The device uses three different visualization schemes to show the deviation of the patients' live body surfaces from their ideal treatment position. Surface measurements captured whilst the patient uses each scheme are compared to data acquired during unaided free-breathing immediately beforehand. Additionally 4D CBCT scans are acquired during free breathing and whilst using the 'traffic light' visualization scheme (Figure 1).

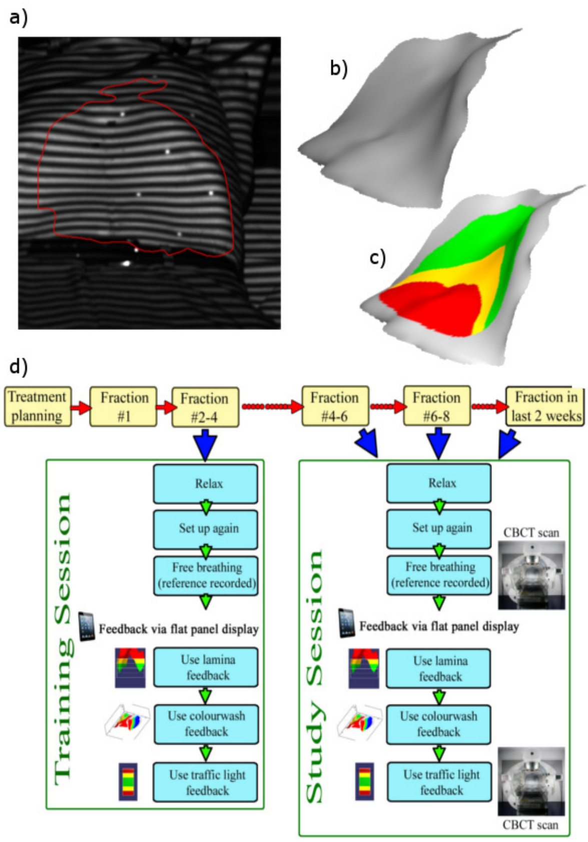

Figure 1 – Showing (a-c) the method of operation of the surface measurement device and (d) the clinical trial protocol. The sensor projects a fringe pattern onto the patient (a), analysis of the modulation of which yields the body topology (b). Deviation of the surface from its ideal is displayed as a colour-wash over the live surface (c) or in more abstract format (d).

Results: Tolerance, measured as the percentage of patients completing all training and imaging sessions, is currently at 100%. Initial analysis shows patients are able to reduce their