heterogeneous tumors. The insert has an outer low-uptake volume encompassing a high-uptake inner volume. SUV ratio of 1:2 was intended. The second phantom accommodates applicators that can hold Farmer ion chamber in a location matching the center of the inner volume and in four locations matching the outer volume. 4D PET/CT scans of the phantom were acquired with three breathing wave forms of ideal sinusoid and two patient-specific breathing patterns fed to the moving platform. Patient-specific wavefronts were selected to represent a regular and an irregular breather. Two scenarios were investigated for image reconstruction, planning and delivery: a gate 30-70 window, and no gating. ITVs were delineated on the obtained 4D PET/CT scans and 21 VMAT-SIB treatment plans were generated with two fractionation regimens:

· Conventional fractionation: 2 Gy/fx to outer ITV, 2.4Gy/fx to high SUV inner ITV, 30 fx.

· Hypo-fractionation delivered in both flattening filter and flattening filter free (FFF) modes: 8 Gy/fx to outer ITV, 9 Gy/fx to inner ITV,5 fx. Treatment plans were delivered in two gating scenarios: no gating and gate 30-70. Two ion chamber readings for the inner ITV, and two readings for one arbitrarily selected outer ITV were acquired. Measured doses in the inner ITV and the outer ITV were compared to planned doses.

Results: For both fractionation regimens and both delivery modes, measured doses in outer and inner ITV were between 93 and 99% of planned doses. Measured dose as compared to planned dose demonstrated independence from breathing pattern or gating window. In particular, measured doses in FFF mode were consistent with measured doses in filtered beam mode, 94-96% of planned dose.

Conclusion: The phantom has been validated for end-to-end use from 4D PET/CT scanning and radiotherapy planning, to dosimetric verification. Measured doses for SIB plans were in reasonable agreement for all three breathing patterns and for both gating windows and delivery modes.

Electronic Poster: Physics track: Inter-fraction motion management (excl. adaptive radiotherapy)

EP-1775

CBCT based prostate IGRT accuracy and PTV margins

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Purpose or Objective: *Purpose*: Image guided radiotherapy (IGRT) is the standard treatment of prostate cancer, widely based on Cone Beam CT (CBCT). The accuracy of CBCT based prostate registration is however not well established, conditioning the choice of the Planning Target Volume (PTV) margins. The goal of the study was to quantify the uncertainty of this registration and propose therefore appropriate margins.

Material and Methods: *Materials and methods*: A total of 306 prostate CT to CBCT alignments were analyzed in 28 prostate cancer patients treated by IGRT. The prostate was manually delineated on all the CBCT. Three prostate alignment modalities were afterwards simulated and compared, based on skin marks, on CBCT registration performed by the technologist at the fraction (IGRTt) and on the prostate contours. The IGRT uncertainty (IU) was defined as the difference between the contour based and the CBCT alignments, in each space direction. Dice index (DI) were calculated. Margins were calculated, based on the IU and the Van Herk formula.

Results: *Results*: The mean (min;max) absolute values of the IU were, in mm: 1.5 (0;10), 0.7 (0;12) and 0.9 (0;7), in antero-posterior (A/P), cranio-spinal (CS) and lateral directions, respectively. After IGRTt alignment, 25 prostate (11% of cases) still projected partially out of the PTV, corresponding to an average prostate volume (min; max) of 2.3 cc (0.0;12.6). The mean + standard deviation of the DI were 0.84 + 0.08, 0.90 + 0.07 and 0.93 + 0.03 for the skin marks, CBCTt and contours registration, respectively. For at least 95% of the IGRT registrations covering 100% of the prostate, the required A/P, CS and lateral PTV margins (mm) should be at least 4.5, 2.0 and 3.0, respectively. The Van Herk PTV margins (mm) were 5.5, 4.1 and 3.0 in the A/P, CS and lateral directions, respectively.

Conclusion: *Conclusions:* CBCT based prostate registration presents uncertainties requiring at least 3 to 5 mm PTV margins.

EP-1776

Assessment of setup uncertainties in modulated treatments for various tumour sites

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Purpose or Objective: The aim of this study was to analise the patients setup errors for various tumor sites based on clinical data from modulated treatments using cone beam computed tomography (CBCT) imagine guidance and portal imaging for breast site. It was also calculated the planning target volume (PTV) margins of all disease sites and stipulated action level for online correction.

Material and Methods: The patients analyzed in this study were treated in our institution between January 2012 and December 2014 with VMAT and IMRT via flash technique for breast cancer. The various tumor sites were divides into six categories; 175 breast (1173 fractions); 53 thorax (475 fractions); 60 prostate (585 fractions); 100 H&N (858 fractions); 100 SNC (789 fractions) and 77 pelvis (620 fractions).

For every treatment fraction, it were acquired KV-CBCT images using the on-board imager (OBI) (Varian Medical Systems), and for breast cancer it were acquired MV portal images using the Electronic Portal Imaging Device (EPID) (Siemens AG) in the first week and twice per week. The registration procedure was performed for all treatments sites according to the tumor localization. For prostate site, it was also analyzed the physiological state of bladder and rectum.

It were calculated the systematic (Σ) and random (σ) errors of couch shift obtained, and PTV margin (2,5Σ + 0,7σ).

Results: The Σ and σ for all treatment sites are summarized in table 1 as well PTV margins.

Table 1. The systematic and random errors and PTV margins