Conclusions: A fast re-evaluation of the dose distribution using small FOV CBCT data is feasible in lung cancer patients. The use of patient-specific HU-to-density tables significantly improves the accuracy of these dose calculations. Only three of the 13 patients needed to be replanned to ensure sufficient target coverage.

PO-0946
Prospective evaluation of patient positioning for interfractional variation in proton therapy of prostate cancer
M. Schneidt1, M. Kovacevic1, J. Thiele2, A. Jakobi1, R. Haase1, S. Makocki2, M. Krause3, T. Hölscher2, C. Richter1
1OncoRay – National Center for Radiation Research in Oncology, High Precision Radiotherapy Group, Dresden, Germany
2University Hospital Carl Gustav Carus - Technische Universität Dresden, Department of Radiation Oncology, Dresden, Germany
3German Cancer Consortium (DKTK) and German Cancer Research Center (DKFZ), Partner site Dresden, Dresden, Germany

Purpose/Objective: To quantify the influence of different IGRT alignment techniques on geometrical and dosimetric consequences for proton irradiation of prostate cancer under consideration of actual occurring interfractional changes in a prospective patient positioning study.

Materials and Methods: Ten prostate cancer patients, treated with photons, were positioned according to an in-house protocol for proton therapy including the application of water-filled rectum balloons. A series of computed tomography data with 10-18 (median 15) in-room control CT scans per patient was acquired on different treatment days during the 8 week treatment for IGRT. Initial proton therapy plans were generated on the pre-treatment CT using passive field formation with two lateral fields. Planning was done on the CTV taking into account beam delivery uncertainties in the field-specific hardware. For evaluation purposes a PTV was created (CTV+5 mm/4 mm dorsal). Based on the control CTs, two different patient alignment approaches were simulated using rigid image registration: (a) Matching of the pelvic bony anatomy (BAM) and (b) Matching based on implanted marker seeds (MSM). For both approaches, the dose distribution per fraction and the accumulated dose distribution were evaluated. For dose accumulation non-rigid deformable image registration of the control CTs with the planning CT was applied.

Results: The preliminary evaluation (7 of the 10 patients) revealed in general an advantage of the bony anatomy matching concerning target coverage. In all patients BAM target coverage was either better or similar compared to MSM. Aligning based on the bony anatomy (BAM) resulted in a mean displacement of the CTV center of 0.5 mm, -1.2 mm and -2.3 mm in the LR-, AP- and SI-direction, respectively. The mean Euclidean shift was 3.4 mm, hence substantially smaller than the CTV-PTV margin of 5 mm and -2.3 mm in the LR-, AP- and SI-direction, respectively. Moreover, for MSM the CTV minimum dose was reduced to a larger extent compared to BAM (on average -20% vs. -14%). The mean dose for rectum and bladder changed relative to the initial treatment plan on average by 12.1% and -15.2% for BAM and 9.5% and -4.9% for MSM, respectively.

Conclusions: From the preliminary results it can be concluded that for proton therapy patient positioning based on bony anatomy is altogether superior to the marker matching leading to adequate dose distributions for both target and organs at risks. The applied uncertainty margins
appeared sufficient for BAM. The slightly inferior results on target coverage for MSM are likely due to the variations of the femoral head positions influencing proton range and dose distribution.

PO-0947
Robustness of dose-painted plans in presence of extensive tumour shrinkage in head and neck cancer
D. Kovacs1, I.R. Vogelius1, J. Rasmussen1, L. Specht1, M.C. Aznar1
1Rigshospitalet 3994, Department of Oncology Section of Radiotherapy, Copenhagen, Denmark

Purpose/Objective: Patients with head and neck cancer can experience considerable tumour shrinkage during their treatment course which in turn can lead to alterations of the planned dose distribution. In this study we evaluate and compare the robustness of standard and dose-painted plans in presence of extensive tumour shrinkage.

Materials and Methods: Eleven patients with extensive in-treatment tumour shrinkage (mean shrinkage 87.2 cm3) were selected for this retrospective study. The patients underwent 3 to 5 CT scans during their course of radiotherapy (RT). Two planning strategies were simulated on this dataset using VMAT: 1) standard integrated boost plans delivering a uniform dose of 2 Gy x 34 to the tumor PTV and 2) a data-driven dose-painting protocol (CONTRAST), in which five different dose levels are given, with the 18F-fluodeoxyglucose PET-positive region receiving 2.35 Gy x 34. An expert radiation oncologist manually contoured the GTV on all in-treatment scans, to which the plans were then transferred and recalculated. The GTV volume as well as the dose to the spinal cord and the mandible were reported. Using the Wilcoxon matched pairs signed rank test we tested the hypothesis that tumour shrinkage causes significant dose increase to the spinal cord and the mandible. Finally we investigated if there was any significant difference in dose increase to these OAR's between the standard protocol and the CONTRAST protocol.

Results: A significant in-treatment dose-increase was found in the spinal cord (p < 0.003) of 1.1 Gy +/-0.9 Gy (median +/-interquartile range) using the standard protocol and 1.2 Gy +/-1.6 Gy using the CONTRAST protocol (illustrated in figure 1, bottom). The increase in spinal cord dose was not statistically different between the two planning strategies (P=0.77).

In the mandible a dose increase of 0.5 Gy +/-0.8 Gy using standard plans and 1.35 Gy +/-1.6 Gy using CONTRAST-plans was found. For patients with a PET-positive volume close to the mandible, the dose constraint to this OAR was clearly violated, as illustrated in figure 1 (top).

PO-0948
Adaptive proton therapy using CBCT to calculate daily dose and range variations
B. Winey1, Y.K. Park1, J. Phillips1, G.C. Sharp1
1Massachusetts General Hospital, Radiation Oncology, Boston MA, USA

Purpose/Objective: To use cone beam computed tomography (CBCT) images for reliable and robust proton dose and range calculations. Scatter induced reconstruction errors are the dominant artifacts affecting CBCT HU accuracy. In order to generate a CBCT image for reliable dose and range calculations, scatter effects must be removed.

Materials and Methods: Two common scatter correction methods were tested: uniform scatter model and a priori CT based scatter generation. Images were acquired for a electron density calibration phantom, multiple anthropomorphic phantoms, and patients selected from multiple treatment locations including cranial, prostate, and thoracic. For the phantom studies the diagnostic CT was considered to be the gold standard for dose and range calculations. For the patient studies, all daily comparisons