setup errors after vertebrae-based setup corrections was 8 mm. 14 out of 20 patients were 'non-movers'. For these patients, margin recipe and coverage analysis showed that 5 mm margins would suffice. For the 6 movers, the creation of an 'average anatomy' adapted planning scan (see figure) was successful, both visually and in reproducing the average baseline shifts to within 0.5±0.7 mm. Margin analysis confirmed that creation of a new treatment plan based on this adapted scan would also allow for 5 mm margin for the movers in remaining treatment fractions.

Conclusions: Baseline shifts for stage III NSCLC patients were accurately determined with both rigid and deformable CBCT registration. Simple rigid registration allowed for a separation into movers and non-movers early in treatment. For the non-movers, planning margins can be reduced when repeat imaging is used to monitor stability. For movers, the proposed creation of adapted planning scans by deformable registration may also allow margin reduction.

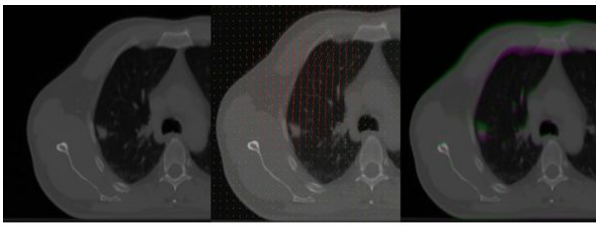

Figure: example of an adapted planning CT scan for a patient with a systematic baseline shift of 7.5 mm in the AP direction.
Left: planning scan. Middle: average warping vector field derived from deformable registration of 3 initial CBCT scans. Right: Adapted scan in green with original scan overlay in magenta.

OC-0403

The potential of MRI-guided online adaptive radiotherapy of urinary bladder cancer

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Purpose/Objective: Adaptive radiotherapy (ART) approaches such as daily plan selection from a library of treatment plans accounts for inter-fractional target motion, but the bladder may also show considerable intra-fractional changes, which becomes even more important in an online re-optimisation strategy. The purpose of this study was to assess target coverage with respect to intra-fractional motion in an MRI-guided radiotherapy (MRIGRT) setting, and to compare the PTV volume for this MRIGRT strategy versus online re-planning using population-based intra-fractional margins (Re-Opt) and to the delivered plan-selection based ART (PlanSelect).

Materials and Methods: Seven bladder cancer patients treated in a phase II trial of PlanSelect using 5 mm isotropic intra-fractional margin underwent weekly MRI (6-7 series pr. patient). Each MRI series consisted of an mDixon sequence (voxel size: 0.9×0.9×1.5 mm; scan time: 40 s) acquired at t = 0, 2, 4, 6, 8, and 10 minutes. The 0 minute scans were used retrospectively for adaptive re-planning in Raystation (v 4.4) using density override with a hypo-fractionated schedule of 36 Gy in 6 fractions. For the MRIGRT strategy, two alternative margins for intra-fractional motion (5 mm isotropic margin; 7 mm Sup and 5 mm in other directions) were added to the 0 minute bladder (CTV_0), and a VMAT plan was optimised. Dose coverage was evaluated on the 10 minute bladder (CTV_10) to assess the effect of intra-fractional motion. Dose accumulation on the pre-treatment MRI-scan (0 min) was performed using deformable image registration with a hybrid intensity-based algorithm. Course-averaged PTV (PTV_c) from PlanSelect as well as population-based intra-fractional margins derived from the van Herk margin recipe (14 mm Sup/Ant, 9 mm Post and 5 mm other directions) were used in a linear regression comparing the PTV_c as a function of the CTV_0 for the different strategies.

Results: With MRIGRT using the isotropic margin three patients had a D1cc of the CTV_10 under 95% of the 36 Gy when assessed with dose summation (Fig 1a); for two of these the same was found using dose accumulation. Using the anisotropic margin one patient had a D1cc under 95% of the 36 Gy when evaluated with dose summation, compared to two patients with dose accumulation. Linear correlation of the PTV_c for all ART strategies, MRIGRT scaled with 1.36 times the CTV_0 whereas the corresponding slopes were 1.65 and 2.28 for the Re-Opt and the PlanSelect, respectively (Fig 1b).

Conclusions: Intra-fractional target motion was found to lead to target under dosage. Online ART has a considerable normal tissue sparing potential. Changing the isotropic margin from 5mm to an anisotropic margin with 7mm increases the target coverage, without major increase in volume. Individualized intra-fractional margins and/or MRIGRT are needed to exploit the full potential of online re-planning for bladder cancer.

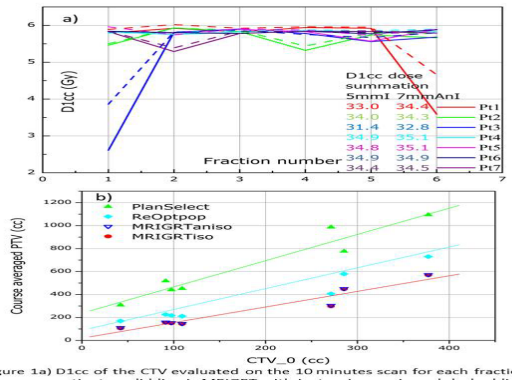

Figure 1a) D1cc of the CTV evaluated on the 10 minutes scan for each fraction for the seven patients, solid line is MRIGRT with isotropic margin and dashed lines are for the anisotropic margin. In dose summation each of the fractional D1cc were added. Patient 1 had a change in bladder shape from 0 minute to the 10 minute scan and Patient 3 had a shift of the bladder in the Ant/Sup direction. b) PTV_c for the different ART strategies as a function of the 0 minute bladder CTV_0 on the first MRIscan acquired. Linear regression lines are shown (R^2>0.93). The regression lines were 1.36 x CTV_0+20cc (MRIGRTiso), the MRIGRTaniso had the same slope and additional 4cc, the Re-Opt (population-based) was 1.65 x CTV_0+62cc, whereas the PlanSelect had a regression line of 2.28 x CTV_0+238cc.

OC-0404

A comparison of two strategies for plan library creation in adaptive radiotherapy of bladder cancer

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Purpose/Objective: Adaptive radiotherapy (ART) for bladder cancer based on daily selection of treatment plans from a plan library is being explored in on-going clinical protocols. Different approaches for creating the plan library have been suggested, based on either multiple planning CTs (acquired in the same session while the bladder is filling) or based on a single planning CT combined with repeat cone-beam CTs