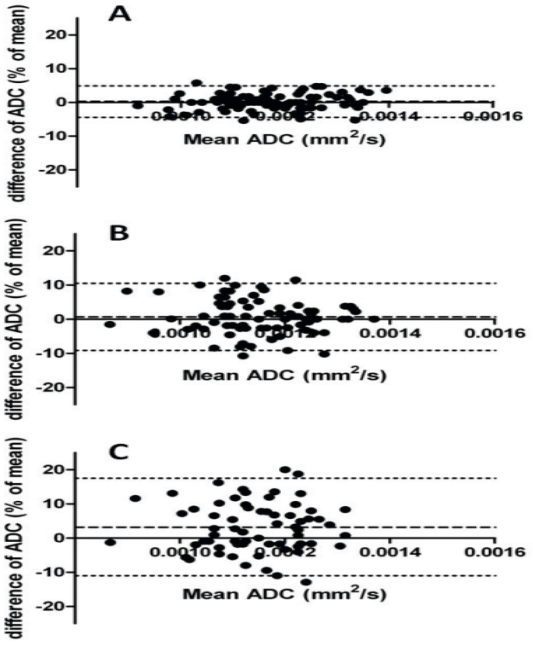

Conclusions: In serial DW-MRI for rectal cancer treatment response evaluation, a repeatability coefficient of 10% has to be considered to account for measurement variations. These variations represent observer judgement and patient and MR spectrometer induced changes.

PD-0413

Assessment of overlap between high FDG-uptake areas in deformed pre-treatment and post-treatment PET scans

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Purpose/Objective: After radiotherapy treatment a tumor residue may remain in the patient, hence showing FDG uptake. If the overlap between this active region and the FDG-uptake area before treatment is high, it might be an indication that the dose delivered was not sufficient to eradicate the tumor. The purpose of this study is to compare the overlap fractions of high FDG uptake areas before and after treatment when the image registration between the two stages is performed using a rigid rotation-translation or using a deformable registration algorithm.

Materials and Methods: For 18 non-small cell lung cancer (NSCLC) patients, two co-registered CT-PET image datasets were available: one scanned before (chemo-)radiotherapy (pre-RT); and one scanned 3 months after treatment (post-RT). First, a rigid registration of the CT datasets was performed; then a volume of interest (VOI) was created based on the PTV, with a 2 cm margin expansion. After this, a deformable registration of the pre-RT CT scan to the post-RT CT scan was performed using the Demons algorithm. The deformation fields resulting from rigid and non-rigid registrations of the CT scan were then applied to the PET scan.
The overlap fractions (OF) between the 34%, 40%, 50% and 60% of SUV_{max} high uptake areas in the original and deformed pre-RT scan and the 70% of SUV_{max} high uptake areas (as a surrogate for tumor residue) in the post-RT scan were finally calculated according to the following definition: OF = (overlapping area/smallest volume).

Results: After deformable registration of the pre-RT PET scan, the overlap fractions (mean±1SD) of the 34%, 40%, 50% and 60% of SUV_{max} high uptake areas with the 70% of SUV_{max} high uptake area in the post-RT scan increased from (67±34)%, (58±33)%, (45±32)%, (37±31)%, (29±30)% to (78±35)%, (74±35)%,(65±31)%, (54±31)% and (49±31)% respectively. These values are shown in figure1.

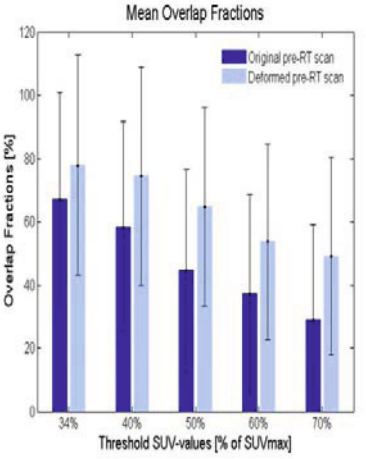

Figure 1: Mean Overlap Fractions between the 34%, 40%, 50%, 60% and 70% of SUV_{max} high uptake areas in the original and deformed pre-treatment scan with the 70% of SUV_{max} high uptake areas in the post-treatment scan.

Conclusions: In the deformed pre-RT PET-scan higher overlap fractions were reported compared to the non-deformed PET-scan, as expected. In the deformed scan the overlap varies from 78% to 49%, in the original scan this is 67% to 29%. This data supports the hypothesis that the treatment resistant regions are located in the high FDG uptake regions prior to treatment. A voxel-by-voxel analysis is necessary, and will be part of our future work.

PD-0414

Biologic targets identified from dynamic 18FDG-PET and implications for image guided radiotherapy.

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Purpose/Objective: The outcome of biologic image guided radiotherapy depends on the definition of the biologic target. Studies have indicated that both metabolism and perfusion may be relevant targets for such dose escalation approaches. The purpose of the current work was to segment images derived from dynamic ^{18}FDG-PET into perfusion and metabolic target regions. Furthermore, to study the dose distributions in the two targets resulting from dose escalation of either the metabolic or perfusion region.

Materials and Methods: Eleven patients with soft tissue sarcomas were investigated with dynamic FDG-PET. The images were analyzed voxel-by-voxel using a two compartment model, and estimates of perfusion and the metabolic rate where produced as parameter maps. The two image series where segmented using Otsu's method and exported to a treatment planning system (Oncentra Masterplan v4.1, Nucletron, the Netherlands). Two biological target volumes were defined from respective maps, BTV_{per} and BTV_{met}, and Dice similarity coefficient was used to compare them. In addition the planning target volume (PTV) was generated from the gross tumor while excluding the respective BTV. A seven field IMRT was set up for a dose painting by contours regime, where PTV was planned for 60Gy and 70Gy to either BTV. Thus, two separate plans were created for each patient with dose escalation of either BTV_{per} or BTV_{met}.

Results: The volume of BTV_{per} and BTV_{met} was 209 ± 170 cm3 and 243 ± 147 cm3, respectively, while Dice coefficient for the two BTVs was 0.75 ± 0.13 (population-based mean and s.d.). For each patient, the resulting dose volume histograms (DVHs) of the PTV, BTV_{per} or BTV_{met} were compared for both plans. For the plan where BTV_{per} is dose escalated, significant differences were found between DVHs of BTV_{per} and BTV_{met}. For instance, D98 was significantly lower in BTV_{met}. The resulting mean dose in BTV_{met} was 67 ± 3.2 Gy. For the plan where BTV_{met} is dose escalated, there were smaller differences between the DVHs. The mean dose in BTVper was in this case 68 ±1.7 Gy. The mean dose in the boost target volume was for both instances 69 ± 1.0 Gy.

Conclusions: In summary; dose escalation of one of the BTVs results in a partial dose escalation of the other BTV, though coverage was not always complete in the latter region. For the patients in question BTV_{met} covered on average a larger region than BTV_{per}. Thus, boosting the metabolic region may offer better coverage of aggressive tumor regions. However, if tumor aggressiveness is equally pronounced in the two regions, this should be taken into account in the treatment planning.