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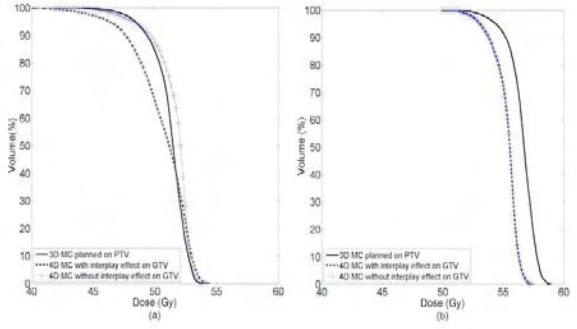
Purpose/Objective: To validate the 'mid-position' approach for lung tumor motion management in helical tomotherapy with 4D Monte Carlo planning simulation, in comparison with conventional ITV.
Materials and Methods: 8 patients with stage I non-small cell lung cancer (NSCLC) treated by SBRT were included, as well as 6 patients with stage II-III NSCLC treated by Simultaneous Integrated Boost (SIB) and participating in a dose escalation protocol. Prior to treatment, a contrast-enhanced CT (CE-CT) and a 4DCT (for SBRT) or a combined 4D FDG-PET-CT (for SIB) were acquired. The GTV, CTV, and OARs were delineated on the CE-CT according to our clinical protocol. Next, 4D data were used to generate first the ITV and then the MidP volume in its exact time-weighted mean position of the respiratory motion, using a validated Morphon non-rigid registration algorithm. The PTVs were finally drawn according to the margin formula for geometric uncertainties developed by Van Herk et al. and adapted to the specific features of lung tumor tomotherapy. For each patient, two treatments were planned based on margins derived from the ITV and MidP volume. Volumetric and dosimetric parameters, as well as conformity indexes were compared with both strategies. Moreover, dose distributions were computed using a 4D Monte Carlo (MC) model, in order to assess the impact of intra-fraction tumor motion on tumor coverage (quantified by D_{95}), with and without the interplay effect.
Results: For SBRT and SIB patients, the PTVs defined with the ITV approach were on average 1.2 times larger than those derived from MidP. Consequently, the dose to all the OARs was on average lower when using the MidP. Nonetheless, the planned dose conformity to TVs was identical between both strategies (0,92 ± 0,03 and 0,84 ± 0,05 for DICE and Paddick indexes, respectively). For all SBRT patients, D_{95} to the GTV computed from 4D MC dose distributions complied within 1% of the planning recommendations when using the ITV approach. In contrast, MidP failed to ensure adequate GTV coverage in 3 patients. For one patient, the simulated interplay effect lowered the D_{95} to the GTV by 4.35% compared to the planned dose distribution (Fig a). Although the interplay effect did not affect the two other patients, simulated MC calculations demonstrated significant GTV underdosages, with D_{95} to GTV reduced by 2.16% and 2.61% compared to the planned doses (Fig b). 4D MC computations are ongoing for the SIB group.



Conclusions: Compared to the ITV, the MidP strategy significantly reduced the PTV and irradiated volumes in all patients. However, if MidP could safely be applied in helical tomotherapy in most cases, it might lead to insufficient tumor coverage for very small tumors (< 5cc) with large motion (> 10mm). Those particular cases are indeed questioning the fundamental hypothesis underlying the framework of the MidP concept. As SIB treatments are usually delivered to large and centrally located tumors, MidP might allow for a safe reduction of the PTVs and irradiated tissues, although this still needs to be further confirmed.

PO-0823
Intensity modulated treatment plans reoptimization with megavoltage cone beam computed tomography dose
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Purpose/Objective: The megavoltage cone beam computed tomography (MV-CBCT) dose may be considered in the treatment plan prescription dose specially for daily image guided radiation therapy (IGRT) treatments. The dosimetric differences on target volumes and organs at risks obtained optimizing the intensity modulated treatment plan (IMRT) with and without the MV-CBCT were investigated for clinical cases routinely treated.
Materials and Methods: A Siemens Medical Solutions, an Artiste™ linear accelerators mounting a MV-CBCT device implemented in Philips Pinnacle3 Treatment Planning System (TPS) was used for this work. Two different type of treatment (head and neck and prostate) performed with daily IGRT-IMRT techniques were enrolled. Twenty prostate carcinomas and twelve head and neck tumors treatment planning were investigated. For each clinical case the dose distribution and the DVH due to IMRT alone (TP1), IMRT plus MV-CBCT dose (TP2), IMRT optimized including MV-CBCT dose (TP3) were examined. D_{mean} and D_{max} were used for target volume comparison and dose volume histograms (DVHs) cut off points for organs at risks (OARs) comparison. The impact of the MV-CBCT protocol used on the integral dose defined as V_{5Gy} was investigated. The CBCT dose calculated was assessed with ionization chamber measurements.
Results: The theoretical treatment plan (TP1) compared with the one optimized with the MV CBCT dose (TP3) did not present difference on target dose coverage, while if compared with TP2 (treatment plan added with MV CBCT dose) a mean increase of 4,1% and 3% were obtained for D_{mean} and D_{max} for ORL and prostate treatment respectively. The OARs sparing was worsened in both comparison also if a better sparing is obtained with TP2. For the parotides glands the Dmean percent difference ranged between +8% and 16 % and for the V40Gy of the rectum the percent difference was between 1.5 to 8%. The comparison between the 8 monitor units (MU) CBCT protocol routinely used and the 5 MU and 15 MU protocols showed and increased of the V_{5GY} integral dose between 10 to 52 % and 20 to 66% for ORL and prostate treatment respectively. The decreased of V_{5GY} integral dose obtained with the 5M CBCT protocol ranged between -2 to -7% for for ORL and between -6 to -13% for prostate cases.
Conclusions: Prostate and ORL treated with IMRT and IGRT techniques may not be performed without the use of the daily CBCT; it is therefore essential to integrate the MV-CBCT dose in the patient prescription.

PO-0824
Comparison of template-based Elekta VMAT plans with IMRT plans generated by the Varian planning system Eclipse
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Purpose/Objective: VMAT is a complex, arc-based treatment technique for intensity modulated radiation therapy. For different treatment planning systems it has been shown that plan quality is comparable to fixed field IMRT. But achieving acceptable plan quality is often based on experience of the operator. This analysis compares the plan quality of template-based VMAT plans without operator interference against fixed field IMRT plans for Elekta linacs using the Varian TPS Eclipse on a statistical basis for various main tumour regions.
Materials and Methods: 181 cases were selected for this study including 40 cervical and endometrial, 73 head and neck, 12 brain, 11 breast and 45 prostate cancer cases. The IMRT plans were developed in clinical routine over the last three years using Eclipse TPS. VMAT plans were generated using a preclinical version of the Eclipse TPS including a VMAT optimizer for Elekta linacs. To standardize the optimizing process, tumour region specific optimizing templates were created. Based on these templates two VMAT plans were generated without interference of the operator: with one full arc (1A) and with two full arcs (2A), resp. one or two partial arcs for breast cancer cases. All plans were evaluated by target coverage, homogeneity and conformity; the organs at risk (OAR) were analysed according to plan objectives such as mean and maximum doses. If one or more objectives were exceeded, a second VMAT plan was created by adapting the optimizing constraints once. All evaluation parameters were averaged over all patients for each region and compared using the Wilcoxon matched-pair signed rank test.
Results: For template-based 2A plans in 27 cases out of 181 an exceeding of the objectives for one or more OAR was found, in 13 cases an over- or under-dosage in the PTV. For 1A plans 30 cases showed an exceeding of the OAR objectives, 25 for the target volume coverage. For the additionally modified plans the OAR exceeding was reduced to 23 cases for both 2A and 1A; the over- or under-dosage in the PTV was reduced to 8 cases for 2A and to 17 for 1A. In comparison to the IMRT plans the 1A and 2A plans showed good results concerning the target coverage. Small differences between the considered techniques can be found which depends on the tumour region. A similar behaviour was found for the OAR. But here, the differences between the different techniques and tumour regions show a wider