Results: Figure 1 displays the mean differences of the dose metrics between repeated CT and CBCT, for Varian and Elekta CBCT scans. For Varian, a good agreement between the dose distributions recalculated on CBCT and repeated CT was observed when a thorax-specific HU-ED table was used. For Elekta, the dose metrics showed larger deviations with the thorax-specific HU-ED table, however, using a patient-specific HU-ED table resulted in similar accuracy as for Varian CBCT dose calculations. Differences between repeated CT and CBCT dose metrics were below 3% for both vendors.

Conclusion: Differences between Elekta and Varian CBCT, including hardware, reconstruction software, HU calibration, FOV and scan length, resulted in different challenges for CBCT dose calculations for the different vendors. For Elekta CBCT scans, the procedure with a patient-specific HU-ED table resulted in similar accuracy as for Varian CBCT dose calculations with a general HU-ED correction for all thorax patients, but is more time-consuming. The vendor-specific corrective methods used in this study, resulted in dose calculations feasible for treatment re-evaluation for both Elekta and Varian CBCT scans.


EP-1812

Adaptive VMAT for cT1-2aN0M0 laryngeal cancer: potential risk of target volume over dosage

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Purpose or Objective: At our department, patients with cT1-2aN0M0 laryngeal cancer are treated with volumetric-modulated arc therapy (VMAT). The treatment plan quality is monitored by plan evaluations on weekly repeat CTs. The purpose of this study was to determine plan quality during treatment by recalculating the actually given dose based on repeat CT.

Material and Methods: Three patients treated with accelerated radiotherapy (66-70 Gy in 2 Gy fractions) were selected because of over dosages exceeding 78 Gy at the transition from air to tissue. Each clinical VMAT plan (plan I) was optimized towards homogeneous dose distributions in the planning target volumes (PTV) and low as possible dose to the critical organs such as the swallowing organs at risk. The treatment plan quality was evaluated using weekly repeat CTs. In addition, two more treatment plans were made including a density override of 0.5 g.cm-3 for the PTV-in-air overlap region (plan II), and the PTV-in-air + 5 mm region (plan III). All plans were evaluated with the PTV-in-air region assigned a density override of 0.0 and 1.0 g.cm-3 to simulate the initial planning scenario and to simulate extension of CTV-in-air, resp. Finally, the “actual given dose” of the clinical target volume (CTV) was estimated by accumulated repeat CT dose evaluations.

Results: The repeat CTs showed an extending CTV towards the laryngeal air cavity over the course of the treatment. Repeat CT evaluations indicated increasing max doses up to 80 Gy. Evaluation of plan I on the initial planning CT, using a density override of 1.0 g.cm-3, showed a potential dose hotspot with similar max dose values (80-87 Gy). When no density override was assigned the PTV (90%) coverage of plan I was sufficient. In contrast, plan II and III showed slightly to moderate PTV under dosage (65 Gy), albeit within the PTV-in-air region. However, the accumulated CTV dose (D100) demonstrated no clinically relevant under dosing in the CTV (methods plan II: 67.4 Gy and plan III 65.2 Gy). Furthermore, the plan optimization approach as used in plan II and III resulted in reduced and acceptable max dose values within the targets (76.9 Gy and 74.3 Gy, resp).

Conclusion: Unacceptable high doses of up to 80 Gy were observed in VMAT plan evaluations based on weekly repeat CTs. To avoid these over dosages, high fluence profiles in PTV-in-air regions should be avoided during planning optimization. An alternative VMAT optimization and evaluation approach has been proposed for cT1-2aN0M0 laryngeal cancer patients.

EP-1813

Clinical implementation of an adaptive planning technique for lung VMAT radiotherapy

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Purpose or Objective: At the Leeds Cancer Centre approximately 40% of lung patients receiving VMAT radiotherapy (RT) display a reduction in tumour volume when imaged using CBCT during treatment. The aim of this work was to develop a method to assess whether the dosimetric impact of observed anatomical changes is sufficiently significant to justify a treatment replan.

Material and Methods: Twelve lung patients receiving FFF VMAT RT planned on the Monaco 3.3 treatment planning system (Elekta) were identified. All had been rescanned, recontoured and replanned due to noted tumour shrinkage. For lung replans the clinical aim is to continue treating the original target volumes, so a rigid registration was performed between the planning CT and the rescan CT using a mutual information algorithm. Target volumes and OAR were transferred from the planning CT to the rescan CT and assessed by a physicist and clinician team to ensure they were clinically appropriate. The original plan was recalculated on the rescan CT studyset and dose volume histogram (DVH) statistics calculated for targets and OARs on the rescan studyset.

Results: For patients who displayed tumour changes without other significant internal changes the transferred target structures were deemed clinically acceptable with minor editing. Comparison of the transferred structures to the replan structures indicated that differences in remarking the targets were larger than image registration and transferral errors. Small variations in spinal cord and lung contours suggest that it is more accurate to re-contour these structures on the rescan CT, especially if they are receiving a dose close to tolerance. This method of adaptive planning was found to significantly reduce the replanning time. A notable limitation of the process was observed for patients who display other significant internal anatomical changes such as a change in lung volume or mediastina position, resulting in inaccurate transferred structures. Based on the DVH statistics for the transferred targets and re-contoured OAR, 9/12 plans required a full treatment replan. Although the target coverage was clinically acceptable the loss of tumour tissue meant that nearby OAR received doses above their tolerance.