OC-0341: Robustness of swallowing-sparing proton therapy for head and neck cancer
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Results: Mean (standard deviation) V95 of the PTV of all plans was 98.6(4.3), and 94.7(5.8) in the recomputed plans on the localization CT (p=0.007). V95 for the GTV was 99.6(4.1) and 99.0(4.7) on the localization and the planning CT, respectively; this difference was not significant (p=0.0549). V98 for the GTV was 82.3(10.9) and 83.5(13.6) on the localization and the planning CT, respectively; this difference was again not significant (p=0.1483).

Conclusions: The coverage of the PTV (5 mm margin) was significantly lower in the recomputation on the localization CT, whereas V95 and V98 of the GTV remained unchanged in this group of patients. The clinical relevance of these changes remains to be elucidated. Jet ventilation appears to be a feasible technique for irradiation of small peripheral tumors with proton therapy. The study of new planning strategies and margin concepts is warranted.

OC-0341
Robustness of swallowing-sparing proton therapy for head and neck cancer
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Purpose/Objective: Proton therapy is more sensitive (less robust) to geometrical uncertainties than photon therapy. Different methods have been proposed to increase proton plan robustness. These methods include robust CT-based planning as an alternative to conventional PTV-margin based planning. Thus, different changes will be combined in the intended improvement for proton therapy. The purpose of this study was to test the robustness of scanned-beam intensity-modulated proton therapy (IMPT) to setup errors and geometrical changes compared to IMRT for head and neck cancer if conventional PTV-margin based planning would be used.

Materials and Methods: In 10 patients with laryngeal or pharyngeal cancer, a planning-CT (CTp) and a repeat-CT scan (CTR) during the course of radiotherapy were made (median interval 25 days). Five patients had relatively small shape changes and 5 patients had relatively large shape changes. Target volumes were delineated on CTp, including a uniform 5 mm margin from CTp to PTV. IMPT and IMRT plans were made with optimal sparing of the parotid glands and swallowing organs at risk (SWOARs). Structures were propagated from CTp to CTR after deformable image registration. Subsequently, rigid registration and plan reconstruction on CTR was performed simulating: 1) no correction for setup errors; 2) off-line correction; and 3) on-line correction.

Results: Planning objectives (including strict criteria for target coverage and dose in critical structures such as the spinal cord) were fulfilled in all plans on CTp. Coverage of the CTV was adequate with IMRT on CT, regardless of the correction method, and with IMPT after on-line position correction. In two patients, the tumour-CTV shrunk with 25% and 28%, respectively. With IMPT this resulted in a spinal cord dose that exceeded the tolerance dose (it ranged from 55.0 Gy to 62.5 Gy in these two cases with the different position correction methods). The mean parotid gland dose was lowest with IMPT on both CTp and CTR, but increased on CTR with IMPT more than with IMRT (see table). On CTR, the mean dose in the SWOARs on CTp was lowest with IMPT. On CTR, the mean dose in the supraglottic larynx was lowest with IMPT. The influence of the setup correction method on the mean parotid gland and SWOAR dose on CTp was relatively small. Dose changes in OARs were mainly caused by changes in patient geometry during the interval between CTp, and CTR.

Conclusions: With conventional PTV-margin based planning, IMPT would be less robust to geometrical changes than IMRT, resulting in reduced gains with regard to the mean dose delivered to OARs on CT. Adaptive CT-based treatment strategies are expected to fully exploit the benefits of IMPT, especially for patients with large geometrical changes. This study defines a reference to quantify the benefit of these proton strategies.

OC-0342
Anatomical changes in mesothelioma patients: effect on proton dose distributions and benefits of early replanning
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Purpose/Objective: To evaluate the dosimetric effects of anatomical changes in patients affected by malignant pleural mesothelioma (MPM) on intensity modulated proton therapy (IMPT) plans and 2) to propose an approach to mitigate this effect.

Materials and Methods: The study was based on the planning CT and either 3 or 4 verification CT scans acquired during the course of the treatment of five patients treated with trimodality approach (surgery + chemo + radiationtherapy). CT scans were registered with automatic rigid registration on bony anatomy. Structures’ contours were copied on the verification CTs and manually adjusted by a radiation oncologist. Changes in the volume of air pockets within the CTV over the treatment course were quantified.

For each patient, a 2-fields IMPT plan was generated on the planning CT and then recalculated on the verification CTs. The effect of replanning early in the treatment cycle was evaluated by replanning on the first control CT (taken after about one week of treatment) and then recalculating on the remaining control CTs.

Results: The CT data showed a systematic reduction of the air volume in the CTV over the treatment course: the mean reduction between the planning CT and last control CT was 80±13% (range: 63-100%). The dosimetric impact on the planned dose distributions is summarized in table. A decrease of V98 in the CTV up to 17.2% was observed, along with an absolute +24% in V107. Dramatic discrepancies were not observed for OARs: the typical increase in mean dose for liver and ipsilateral kidney was 2Gy and 3Gy, respectively. However relative differences up to 40% were found in V40 for esophagus. The IMRT plan provided similar results as IMPT concerning target coverage, while for OARs it is more robust. However even after the last recalculation IMPT is still better. When IMPT treatments were re-planned on the first verification CT and then recalculated on the remaining verification CTs, smaller differences were found (see figure), especially concerning the target coverage (on average V98 decreased only by 4.7%). For both the liver and ipsilateral kidney the mean dose increase was less than 1 Gy. A 4D-CT scan was acquired for one patients to assess intrafraction organ motion. Results showed no impact.