AbstractID: 1488 Title: Incorporation of biological imaging voxel intensity information into the IMRT optimization algorithm

In head and neck cancer, IMRT can reduce side effects but the present technology limits the maximal dose escalation. Most loco-regional relapses still occur in the high dose regions. Progress in PET and MR imaging might enable us to identify the tumour's radioresistant regions. Developing an IMRT technique to target these regions with a higher biologically effective dose seems self-evident. Biological images consist of an array of spatially located voxels with signal intensities quantitatively related to a radiobiological parameter. The purpose of this study was to incorporate voxel intensities directly into the IMRT optimization algorithm. A linear model, relating relative voxel intensities to intended dose values, was implemented in the bio-physical objective function used by the IMRT optimization. As proof of principle, a patient case was planned. The 70-year old patient was diagnosed with a squamous cell carcinoma of the larynx, staged as cT3 cN1 M0. [¹⁸F]FDG-PET images were fused with CT. An empirically determined dose escalation from 69.1 to 121 Gy was modelled from the median to the 99th percentile FDG-PET voxel intensity value within the Planning Target Volume (PTV). The FDG-PET optimized plan was evaluated by calculating the obtained-to-intended dose ratios in the voxels within the PTV, resulting in a relative dose-volume histogram. For 38.4% of the volume, the obtained-to-intended dose ratio was > 1. For 78.8% of the volume, this ratio was < 0.9. These results indicate that biologically directed dose escalation by incorporation of voxel intensity information into the IMRT optimization algorithm is technically feasible.