AbstractID: 11156 Title: Combined use of CT and MVCBCT for optimal dose calculation in presence of high-Z material

Purpose: High atomic number (Z) materials such as dental fillings complicate the use of conventional CT images and application of the superposition dose calculation algorithm. This work investigates the accuracy of current planning methods for patients with dental work and proposes to combine the strengths of two imaging modalities in order to obtain a more realistic dose distribution in presence of high-Z materials.

Method and Materials: Dose simulations were performed on conventional CT and megavoltage cone-beam CT (MVCBCT) images calibrated for electron density. MVCBCT images were acquired on a phantom and patient using two MVCBCT beam lines having substantially different energy spectra. Dose measurements on a cylindrical phantom with an ion chamber and MOSFET detectors were compared to simulations performed in Pinnacle and with Monte Carlo. Monte Carlo simulations used EGSnrc/BEAMnrc code with a treatment head model that produced a close match to measured data. Phantom and patient CT images were simulated with MCRTP using a voxel resolution of 3mm.

Results: MVCBCT produced much less high-Z artifact than CT. MVCBCT images from the highest energy beam with low energy photons filtered out had the least artifact but the lowest soft-tissue resolution. Dose measurements on phantom were much closer to simulations performed with Monte Carlo (2-5%) than Pinnacle (7-14%). Simulations indicate that Pinnacle underestimates dose in soft tissue adjacent to fillings as well as attenuation through the high-Z material. This could result in a hotter gum dose and underdosage of the target volume.

Conclusion: Combined CT-MVCBCT images of head and neck patients are being used with Monte Carlo to quantify the dosimetric impact of dental fillings for IMRT and 3DCRT. In absence of corrective measure, constraints on dental contours could be used to limit the number of IMRT segments entering through the high-Z material before reaching the tumor.