AbstractID: 10144 Title: Dosimetric characterization of an imaging beam line with a carbon electron target for megavoltage cone beam computed tomography

Purpose: Megavoltage cone beam CT image quality can be significantly improved with an imaging beam line (IBL) with no flattener and a carbon electron target. The IBL imaging dose is non-negligible, however, and the high keV-range x-ray fluence makes beam modeling nontrivial. An IBL was modeled with the Philips Pinnacle^3 treatment planning system, verified experimentally, and applied to clinical cases.
Method and Materials: The IBL was modeled and the image acquisition dose was verified in a customized acrylic cylindrical phantom with 196 ion chamber measurements. Agreement between the measured and modeled IBL dose was quantified with the 3D γ-index. Representative IBL and TBL imaging dose distributions were calculated for head and neck and prostate patients and included in treatment plans using the imaging dose incorporation (IDI) method. Surface dose was measured for the TBL and IBL for four head and neck cancer patients with metal oxide field effect transistors.
Results: The depth dose and profile curves had 97% passing γ-indices for dosimetric and distance acceptance criteria of 3%, 3 mm, and 100% passed for 5.2%, 5.2 mm. For the ion chamber measurements of phantom image acquisition dose, the IBL model had 93% passing γ-indices for acceptance criteria of 3%, 3 mm, and 100% passed for 4%, 4 mm. Differences between the IBL- and TBL-based IMRT treatment plans created with the IDI method were dosimetrically insignificant. IBL surface dose was greater than TBL by 18% ($p = 2\text{x}10^{-6}$).
Conclusion: The IBL can be modeled with acceptable accuracy using a standard TPS, and accounting for IBL dose in treatment plans with the IDI-method is straightforward. The resulting composite dose distributions, assuming similar imaging doses, are negligibly different from those of the TBL. The increased IBL surface dose relative to the TBL is likely clinically insignificant.
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