AbstractID: 11045 Title: Configuration and validation of a double Gaussian dose model for scanning proton beams

Purpose: To configure and validate an improved dose model of a treatment planning system (TPS) for scanning proton beams (SPBs) with a double-Gaussian function for the in-air lateral profiles.

Methods: The double-Gaussian dose model implemented in the TPS requires two additional parameters: the relative weight and the width of the second Gaussian. The weight is a constant for all energies and the width can vary with energy. These parameters are unsatisfactorily derived by the TPS and therefore must be obtained empirically. The relative weight was first determined by comparing measured and calculated doses in water as a function of field size for the lowest, intermediate, and highest energies. The width of the second Gaussian was then determined by fitting the field size dependence of the measured doses. This procedure was performed for approximately every 10 MeV at two different depths, at 2 cm and near the Bragg peak. To validate the dose model, we compared calculations and measurements for depth doses for spread out Bragg peak (SOBP), lateral dose profiles, doses at the center of SOBPs as a function of field size, range and SOBP

Results: Calculated and measured depth doses and lateral profiles of rectangular target volumes agree very well. The measured dose dependence on field size can be accurately predicted by calculation within ±1.5%. For fixed field size, the measured dose at the center of SOBP as a function of range and SOBP also agrees with calculation within ±2%.

Conclusions: We have demonstrated that the double-Gaussian model has improved significantly compared with the single-Gaussian model in prediction of the PTCH SPBs. However, our results suggest that the halo dose may not be correctly modeled. Further investigation is needed to understand the limitations of the double-Gaussian model. Nevertheless, the current implementation of the double-Gaussian model is clinically acceptable.