AbstractID: 8219 Title: A complete predictive model for a dedicated ocular proton radiotherapy beamline

Purpose: To report on our establishment of a complete prediction model for a proton therapy delivery system exclusively used for the treatment of ocular melanoma.
Method and Materials: Our ocular beamline, with a maximum range (*R*) of 4cm, employs a large library of range modulator wheels to deliver flat SOBPs with any *R* and almost any modulation width (*M*). We quantified the effect on the output of *R, M,* aperture size, off-axis ratio, and modulator wheel design. Output measurements were obtained for an extensive set of SOBP ranges, modulation widths, and field sizes.
Results: For the output model to be applicable for both partial modulation (M_{90}<R) and full modulation (M_{90}≥R), it was essential we adopted the use of M_{100}, i.e. the distance between the proximal and distal 100% isodose level. Applying a modified version of the output prediction model by Kooy and Bortfeld, based on a single parameter 'r' equaling $(R-M_{100})/M_{100}$, we obtained an accuracy of 5.1% (1SD). Extending the model with a linear correction for the range, of about 11% per cm, reduced this accuracy to 1.9%, with a 95% confidence interval of –3.2% to 4.1%. Over a range of aperture sizes from 8mm to 28mm diameter the output increased linearly with 2%. Smaller apertures show a large reduction in output due to proton dis-equilibrium but are not used for clinical treatments. The individual design of modulator wheels had a negligible effect when the SOBP is flat. The off-axis ratio was smaller than 1%.
Conclusion: Range and modulation are controlled within 0.5mm. Using M_{100} and extending the output prediction model with a linear range effect, allows us to predict outputs for both partial and full modulation SOBPs to within 1.9% (1SD), which we deem to be clinically acceptable.