AbstractID: 9235 Title: Dosimetric comparison of proton delivery techniques: double-scattering and uniform-scanning

Purpose: To compare proton dose distributions generated with double-scattering to uniform-scanning for different clinical sites
Method and Materials: The 'universal nozzle' developed by IBA incorporates several delivery modes. In *double-scattering* (DS) a flattening filter scatters the proton beam into a flat circular profile. In *uniform-scanning* (US) two dipole magnets scan the beam into a rectangular profile. US covers larger volumes both laterally and in depth, and has dosimetric characteristics that are different from US. This study deals with cases that can be treated with either US or DS. Eclipse (Varian) treatment planning is commissioned for both delivery modes. Comparison of water-phantom calculations to measurements validates the treatment-planning algorithm. We compare the dose for the following sites: prostate (2 cases), head-and-neck (4 cases), cranio-spinal (3 cases). Dose-volume-histograms are used to evaluate target coverage and dose to critical structures.
Results: The US in-air penumbra is typically smaller because of less scattering material in the beam path. For a range of 15.0g/cm^2, modulation of 8.0g/cm^2, and air gap of 12.0cm, the 80%-20% penumbra at 11.0cm depth is 4.4mm in US and 6.9mm in DS. In addition, the US distal fall-off is sharper because of reduced energy straggling in the treatment head. For a range of 5.0 (28.0) cm in water the 80%-20% fall-off is 2.7mm (5.5mm) in US, compared to 4.0mm (6.0mm) in DS. For deep seated tumors (prostate) the sharper in-air dose distribution in US is washed out by in-patient scatter, resulting in no significant benefit. For targets at shallow and intermediate depth, located next to a critical structure, the sharper fall-off in US allows for better target coverage and less dose to the critical structure.
Conclusion: The sharper lateral and distal penumbra in uniform scanning are beneficial when the target volume abuts a critical structure. For deep-seated tumors this advantage diminishes.