AbstractID: 10209 Title: Treatment quality sensitivity to varying beam spot size and number of fields in intensity modulated proton therapy

Purpose:
Clinical proton pencil beam scanning (PBS) systems are now commercially available. These systems can provide beam delivery that results in uniform field dose or intensity modulated proton therapy (IMPT). This study considers the effects of varying PBS transverse dimensions (beam σ using the Gaussian profile) and number of fields on a series of geometric cases and clinical cases.

Method and Materials:
A 3-12 mm range of beam σ in air over the range 150-230 MeV was modeled in a pre-clinical treatment planning system with Monte Carlo (MC) dose calculation capability. To investigate the sensitivities of treatment quality from the beam σ a series of treatment plans of virtual geometric phantoms and example clinical cases were generated using 3, 6, 9, and 12 mm σ. The phantoms/cases were paired as 1) base of skull (BOS) 2) prostate and 3) lung. A quantitative plan quality index (QI) was used for inter-comparison.

Results:
The results from the QI scores are self-consistent between all the paired phantom/clinical cases. Specifically the spread in QI scores between beam sizes and numbers of field as observed in the geometric phantoms were also observed in the related clinical cases. The BOS and prostate cases/phantoms QI's indicated a significant sensitivity to beam size whereas the lung case/phantom did not.

Conclusion:
This study indicates that treatment quality sensitivity to beam σ is low for targets not immediately proximal to critical structures. For higher definition targets the study indicated that beam σ's in air of ideally 3-6 mm, but possibly up to 9mm may provide acceptable results depending on the number of beams used, the physical separation of the target and OAR, as well as the dose differential required between them.