AbstractID: 5493 Title: Aperture-based beam delivery for intensity modulated proton therapy

Purpose: Treatment planning for intensity modulated proton therapy (IMPT) has traditionally used an approach in which the intensity and energy for each beamlet are modulated, which requires high dose-rate beam scanning capabilities. The purpose of this work is to develop a new proton beam delivery method for IMPT without the need for high dose rate beam scanning.

Method and materials: In this study, an aperture-based method to deliver a uniform dose to a target volume has been investigated. For a target with a flat back surface, a broad proton beam is collimated with an aperture conformed to the cross-section of the target at a specific depth. The proton beam has a small energy spread to cover a 0.5-1.0 cm depth range. The mean energy and the weight of each proton beam are varied to produce a uniform dose distribution in the whole target volume. For an irregularly shaped target located in patient body, a compensator is used to provide equal beam path lengths to the back surface of the target. This will create an equivalent back surface for the target and then it can be treated in the same way as for the target with a flat back surface. A Fluka based Monte Carlo package has been used for dose calculation in aperture-based IMPT treatment planning.

Results: We have tested aperture-based IMPT planning on a variety of patient cases. The results demonstrate that it can produce highly conformal dose distributions using only five to six apertures per beam direction. As compared with scanning beam delivery, our studies demonstrate that aperture-based beam delivery can result in a significant reduction in both the number of beam segments and the number of monitor units.

Conclusions: Aperture-based IMPT optimization results in highly efficient treatment delivery while maintaining the dosimetric benefits of IMPT.