Purpose: To conceive, develop, and characterize a fan beam proton therapy system able to deliver intensity modulated treatments, designed for use in conjunction with an isocentric gantry and capable of being retrofit onto existing passive scattering systems.
Methods: A range and intensity modulation device was developed to selectively modulate channels of protons within subsections of a fan beam. Simulations were performed using MCNPX to optimize various aspects of the design, most importantly being the size of the fan subsections affected by individual modulation channels. Due to the complex geometry of the modulator, an MCNPX-based treatment planning system was developed to obtain accurate results. Phantom studies were performed to test the capabilities of the system, and later CT data was incorporated into the MCNPX simulations in order to calculate dose to a patient using clinical contours and objectives.
Results: For individual beam channels ranging in size from 0.5 to 2.1 cm, dose spots sizes are between 2.0 and 4.5 cm full width at half-maximum. While these are large, homogeneous dose distributions are achievable with little dependence on channel width when delivered from 29 angles. Dose coverage near a target edge suffers if delivery angles are reduced below approximately 10-15 angles. Treatment plans on a clinical dataset indicate that the system would likely be clinically acceptable, producing homogeneous target coverage with an estimated treatment time of 15-20 minutes per patient.
Conclusions: A fan beam system to deliver IMPT in an isocentric geometry has been developed and simulated. Since significant scatter occurs in the range and intensity modulator device, MCNPX was used in order to accurately characterize the system and evaluate its capabilities. With a minimum of approximately 15 treatment angles, the system can deliver conformal and homogeneous doses to both phantom and clinical targets in reasonable timeframes.

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