AbstractID: 5798 Title: Implementation and comparison of several proton IMRT algorithms

Purpose: To computationally compare the plan quality provided by 3 different intensity modulation proton therapy (IMPT) techniques: 3D modulation; 2.5D modulation; and distal edge tracking (DET) with optimization. Plan quality, problem size, and efficiency were assessed.

Method and Materials: The dose calculation was based a finite sized beamlet model, which was 1x1 cm^2 at isocenter. The dose from each beamlet was the superposition/convolution of infinitesimal pencil beams falling within the beamlet. Ray tracing to each voxel was performed for each beamlet to find out the radiological depth to each voxel. In the 3D modulation algorithm, a stack of Bragg peaks were placed between the maximal and minimal radiological depths of targets passed by a beamlet with 2.5 mm spacing. The fluence of each Bragg peak was modulated independently by the optimizer. The placement of the Bragg peaks in the 2.5D algorithm was similar to the 3D algorithm, but the Bragg peaks belong to a beamlet were pre-optimized to make a spread out Bragg (SOBP) whose dose level was equal to the prescription dose of the target it passed. The weights of SOBPs were optimization variables. In the DET algorithm, the Bragg peaks were set at the distal edge of the targets.

Results: The 3D algorithm could produce the best plan with least beams, but the data size was large. The DET was most efficient in dose calculation and fluence map optimization, its plan quality was fair. The advantage of the 2.5D algorithm was in its small data size and efficiency in fluency map optimization.

Conclusion: An appropriate algorithm should be selected to meet the trade-off of plan quality versus computational and delivery efficiency.

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