

AbstractID: 5687 Title: 3D intensity modulated proton therapy with minimal beam number

Purpose: We investigate the influence of beam number on the quality of intensity modulated proton therapy (IMPT) treatment planning with 3-dimension (3D) modulation. Getting a good quality IMPT plan with the least beam number is critical to reduce delivery time. We seek the minimal beam number required to meet the treatment plan criteria.

Method and Materials: An IMPT treatment-planning study was run employing an in-house treatment planning system that applied a density-scaled finite proton pencil beam dose model. The dose model ray traced to every voxel in each beamlet with an isotropic 2.5 mm voxel grid (Shannon-Nyquist limited). A 3D fluence modulation algorithm was employed using 1 x 1 cm² beamlets with mono-energetic ranges having 2.5 mm steps between Bragg peaks along the range of the beamlet where it intersects the targets. Plans were run for 23 head and neck cases with 1 to 4 manually placed beams. The beams angles were selected to avoid critical structures if possible. We started with 4 beams then decreased the beam number while manually adjusting the beam angles for each case until we were unable to meet the planning criteria. Plans were compared with 7 beam 6 MV photon IMRT plans.

Results: Out of 23 cases: 1 beam was sufficient for 3 cases, 2 beams were sufficient for 12 cases, 3 beams were required for 6 cases, and the 2 most difficult cases needed 4 beams. Plan quality for IMPT and IMRT were comparable with IMPT having less dose to normal tissues.

Conclusion: The beam number required for an IMPT plan with 3D modulation can be reduced to a small number by using manual beam angle adjustment. This result indicates that beam angle optimization should be very valuable for IMPT.

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