Evaluating Dosimetric Differences Between Flattening Filter-Free (FFF) and Flattened Beams for Small Bowel Sparing in Abdominal Soft Tissue Sarcoma

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Abstract

Abdominal soft tissue sarcoma (STS) is a rare malignancy that presents a major challenge in radiation therapy due to its proximity to radiosensitive organs, particularly the small bowel. Radiation-induced bowel toxicity remains a significant limitation in achieving optimal target coverage and can lead to severe clinical complications. Previous studies have shown that flattening filter-free (FFF) beams can reduce peripheral dose and treatment time in other disease sites; however, their dosimetric advantage in abdominal STS has not been established.

The aim of this study was to determine whether 6 MV FFF photon beams improve small bowel sparing compared to conventional 6 MV flattened beams in patients with abdominal STS. A retrospective dosimetric comparison was performed using volumetric-modulated arc therapy (VMAT) plans for 10 adult patients previously treated with 6 MV flattened beams. For each case, a corresponding 6 MV FFF plan was generated using identical contours, geometry, and a prescription dose of 50.4 Gy in 28 fractions. Both plans were normalized such that 95% of the planning target volume (PTV) received 100% of the prescription dose. Small bowel dosimetry was measured using standard dose - volume histogram metrics to support hypotheses testing. Results showed that overall bowel dose differences between 6 MV FFF and flattened beam plans were minimal and not statistically significant across most parameters. However, flattened beam plans demonstrated significantly lower small bowel maximum dose compared to FFF plans. These findings suggest that FFF beams do not provide a dosimetric advantage for small bowel sparing in abdominal STS and that conventional flattened beams may remain preferable for this treatment site.

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