

Purpose: This study explores the methodology of determining accumulated delivered dose using deformable registration. The aim of the study was to examine the inter-fraction variation of dose delivered to the patient and to compare the voxel-by-voxel accumulated dose with the planned dose.

Methods: Five prostate patients treated with a rectal balloon using the same 12-fraction Hi-Art Tomotherapy technique were studied. The dose was calculated on the pre-treatment MVCT images of each fraction. All 12 dose grids were then accumulated on the 12th fraction MVCT using adaptive tools in the Pinnacle treatment planning system (v9.100). The rectal wall and prostate were outlined on each fraction's pre-treatment MVCT for each patient to study the inter-fraction dose variation.

Results: The absolute volume rectal wall DVHs for each fraction vary from fraction to fraction with rectal balloon volume, but the overall shape of the DVH curves is preserved. The accumulated absolute volume DVH shows a discrepancy from the planned DVH depending on how well the rectal wall volume on the 12th fraction MVCT agrees with that on the planned image. The planned and accumulated normalized DVH (normDVH) for prostate agreed well. For one patient, the normDVH for rectal wall was greater than the planned normDVH in high dose range, which was attributable to a large over-inflation of the rectal balloon for a single fraction. For another patient, the balloon volume as measured on the KVCT was much greater than that on the MVCTs. This caused the accumulated rectal wall normDVH in the high dose region to be lower than planned. For the prostate, the planned doses and the accumulated doses agreed well for the normalized DVHs.

Conclusions: Demonstrating the utility of deformable registration methodology, these results show that consistency of delivered rectal wall doses is dependent on the consistency of the rectal balloon volume.

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