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Experimental comparison of spot, raster and line scanning and their effectiveness in mitigating tumor motion using rescanning

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INTRODUCTION

• Particle therapy centers and vendors around the world offer three different types of beam scanning:
  ○ spot scanning (SS) (e.g. PSI, MD Anderson or IBA)
  ○ raster scanning (RS) (e.g. HIT or Varian)
  ○ line scanning (LS) (e.g. PSI or Sumitomo)
• They differ in their delivery dynamics and produce unequal interplay patterns in case of moving target irradiations.
• To compare the differences, we emulated all three scanning techniques on our Gantry 2.

RESULTS

• All three plans have identical dose-volume histograms if the target is static (ΔD,ΔV < 0.02%).
• We see this confirmed when measuring absolute dose distributions at center SOBP without moving the 2D array of ionization chambers (ICs).
• In free breathing (simulated with a programmable, sliding table), volumetric rescanning (green bars) decreases inhomogeneity inside the CTV further than layered (yellow bars), especially for LS.
• RS and LS deliver dose faster than SS saving ca. 40 and 50 sec., respectively, when rescanning six times in volumetric sequence.
• At the same time, SS and LS show comparable inhomogeneity scores (~6%). Residual inhomogeneity for RS remains higher at ~8%.
Conclusion: LS might be a fast and effective delivery technique to treat moving targets using rescanning.

REFERENCES


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