

AbstractID: 5209 Title: Treatment of moving targets with scanned ion beams: a comparison of different strategies

Purpose:

To compare internal target volume (ITV), gating, rescanning, and motion compensation (tracking) for treating moving targets with a scanned carbon ion beam based on time-resolved computed tomography (4DCT) data for 4 patients.

Method and Materials:

The GSI treatment planning system TRiP has been extended to calculate dose distributions in the presence of motion. Calculations are based on 4DCT data and corresponding deformation maps. To account for respiratory target motion and time dependent irradiation with a scanned carbon ion pencil beam, the treatment plan is temporally divided into sub-plans. Treatment plans were generated for 4 lung-tumor patients. Each plan consists of 1 field to the CTV with margins appropriate for tumor motion. For each patient and technique, 12 combinations of respiratory period and initial breathing phase were studied. Total dose distributions under respiratory motion were compared to a reference treatment plan at end-exhale (without motion) by dose volume histograms and mean lung doses.

Results:

The ITV concept showed severe misdosage caused by interplay between target motion and scanned ion beam. Gating, rescanning (30x), and motion compensation resulted in adequate target coverage for all patients. In comparison to the reference, mean lung dose was similar for motion compensation, but increased by 10-15% for gating, and by ~40% for rescanning.

Conclusion:

An ITV treatment strategy results in severe under- and over-dosage of moving targets. Gating, rescanning, and motion compensation assure target coverage. Mean lung dose is increased for gating and rescanning.