AbstractID: 6950 Title: The impact of SBRT treatment techniques on dose delivery in presence of organ motion and deformation

Purpose: The impact of organ motion and deformation has been studied for conventional radiation therapy. The cumulative dose is usually a blurred version of the static plan after motion-induced hot and cold spots average out over a large number of fractions. However, for stereotactic body radiation therapy (SBRT) treatment where 1-6 fractions with large fractional doses are typical, such impact needs investigation.

Method & Materials: Five liver SBRT cases were studied. The targets were located in different regions of the liver where motion and deformation varied. 4D-CT images were acquired and sorted into 5 breathing phases via external breathing signals from a respiratory management system. For each case, three static plans were generated using 3D conformal (3D), dynamic arc (DARC) with MLC reshaping to target during gantry rotation, and IMRT with dynamic MLC delivery techniques.

The spatial/temporal interplay of radiation beam (e.g., gantry/MLC motion) and organ motion was studied using in-house software. The segmented doses delivered to each phase were registered using a deformable registration algorithm. The delivered to the target and other organs with and without motion were compared.

Results: For each case, the three static plans were of equivalent quality. When the interplay of radiation beam and organ motion was included, dose coverage to ITV deteriorated. For the worst case, the D98/D95 changed 4.1%/2.9%, 14.4%/10.8%, and 23.3%/28.1% for 3D, DARC and IMRT techniques, respectively. For the best case, the D98/D95 changed <2.1% for all 3 techniques. For case #2 where PTV was close to the kidney, the mean dose to the kidney changed from ~2% to ~5% when motion was included.

Conclusion: The spatial/temporal interplay of radiation beam and organ motion causes deterioration of the dose coverage. Overall, 3D plans had the least and IMRT plans had the most variations between planned and delivered dose distributions.