

AbstractID: 3719 Title: Monte Carlo Dose Verification for MRI-based Treatment Planning of Prostate Cancer

Purpose:

Modern radiotherapy requires high accuracy for dose calculation and beam delivery. In this work, we used the Monte Carlo method to validate the dosimetry accuracy for MR based IMRT treatment planning for prostate cancer treatment.

Method and Materials:

Fifteen prostate cancer patients were scanned on both a CT simulator and a 0.23 T open MR scanner and the IMRT plans were made for these patients. Monte Carlo simulations were performed for these patients using homogeneous geometry based on CT and MRI, and heterogeneous geometry built based on CT numbers or different bulk densities for MR contoured bony structures. The homogenous density was chosen as 1.0g/cm³ and the density of bone was chosen in the range 1.5 – 2.0 g/cm³. Isodose distributions and DVH were used in comparison.

Results:

For coplanar IMRT treatments, the mean dose values of the GTV for homogeneous geometry based on CT was about 2% higher than those for heterogeneous geometry based on CT. The difference in the mean GTV dose between homogenous MRI and heterogeneous CT geometries was always less than 3%. After applying heterogeneity correction to the femurs for MRI, the difference was reduced to < 2%. The DVH curves agreed within 5% in dose or volume among these plans. For the critical structures, all the plans calculated using CT or MRI met our clinical acceptance criteria. For non-coplanar treatments, a maximum 7% discrepancy was found in the GTV dose between homogeneous and heterogeneous geometries due to the significant attenuation of the oblique beams going through the femurs. For MRI-based planning, the discrepancy was reduced to 2% if the femurs were assigned a bulk bone density in the dose calculation.

Conclusion:

Our results show that MRI-based IMRT planning meets the accuracy requirement for radiotherapy treatment of prostate cancer and it has been implemented clinically.