AbstractID: 2813 Title: The impact of prostate IMRT on radiation induced malignancies

Introduction: The application of intensity-modulated radiation therapy (IMRT) in the treatment of prostate cancer has provided a tool to deliver high doses to the target volume while sparing surrounding critical structures. The drawback of intensity modulation, as implemented using computer-controlled multileaf collimators (MLC), is the larger number of monitor units (MU) and more beam directions used compared to conventional radiotherapy. Concerns have been raised that the widespread use of IMRT could lead to an increase in radiation-induced malignancies (RIM) due to more normal tissues being exposed to low dose radiation.

Methods and materials: The EGS4/BEAM code was used to simulate detailed accelerator geometry to generate phase space data for the clinical beams in our department. Using patient CT data with the EGS4/MCSIM code, we calculated the dose to the patient for IMRT and conventional treatments. Based on the doses received by the risk organs away from the target we calculated the total whole-body dose equivalent and estimated the risk of RIM.

Results: IMRT increases the leakage dose but not the scatter dose to risk organs. IMRT uses more MUs (3-8 times) than conventional treatments. For a 10MV photon beam, the estimated percent likelihood of a fatal second cancer due to 72 Gy was 0.5% for conventional treatment and it ranged from 0.6% to 1.6% for prostate IMRT depending on the energy, the accelerator/MLC design and the optimization/leaf sequence algorithms used.

Conclusions: The increased leakage radiation due to IMRT results in an increased risk of RIM. Analysis of the dose volume histograms and the corresponding TCP, NTCP and the relative risk of RIM may help develop guidelines for IMRT treatment planning in selecting treatment technique, beam energy, beam delivery methods and plan acceptance criteria.