AbstractID: 10504 Title: Investigation of an in house Monte Carlo based inverse planning system for mixed beam radiation therapy

Introduction: This work aims to investigate an in-house Monte Carlo based inverse planning system developed for mixed beam radiation therapy (MBRT) planning using realistic 3D phantom/patient geometries.

Material and methods: The MCBEAM code was used for accelerator simulation. MCPLAN, an expanded version of the MCSIM code developed for inverse treatment planning, was used for the planning process. First, dose deposition coefficients were calculated using MCPLAN for the selected photon and electron beams. Optimizing the total dose distribution by changing the weights or intensities of individual photon and electron beamlets resulted in 2-D intensity maps that are converted to multileaf collimator (MLC) leaf sequences for delivery. Monte Carlo simulations of the electron MLC (eMLC) fields were performed, which were used as a new set of beamlets for a second optimization, which is an essential step to model the contribution of electron scatter and transmission from the eMLC. Optimization was performed to optimize segment weights resetting the weights in leaf sequences for each segment and calculating the final dose.

Results: Good agreement was achieved between simulated and measured PDDs and profiles for all photon beams collimated by the photon MLC and electron beams collimated by the eMLC. An MBRT plan was generated having 25 segments. Four segments were tangential photons of 6 MV beam energy while the remaining segments were electron beams with energies 6, 9, 12, and 16 MeV .The dose volume histogram was calculated showing good coverage of the target volume and proper sparing of the distal critical structures.

Conclusion: Our Monte Carlo code is capable of accurately modeling photon and electron beams. The in-house treatment planning system can generate deliverable MBRT treatment plans using realistic 3D phantom/patient geometries. Further clinical studies are underway.