AbstractID: 5783 Title: Monte Carlo Dosimetric Evaluation of Patient Intra-fraction Motion

Purpose: to include the patient intra-fraction motion into a Monte Carlo-based treatment planning system.

Materials and Methods: the PENELOPE Monte Carlo code was used along with a mathematical phantom consisting of a target shape (water) that surrounds a critical structure (bone). Both structures are embedded in a cylindrical water phantom. Two types of motion were modeled: shifting and deformation both periodic in time. It is assumed that deformation does not alter the density of the structure and that no movement occurs during the tracking of a single particle history. A PENELOPE subroutine was designed that performs the simulation in the following way: at the beginning of a history a configuration of patient geometry is sampled from a probability distribution with equi-probable bins. Each bin describes a particular state during the evolution of the geometric configuration. Once the configuration is selected, a history is started and followed under the geometry selected until it is terminated; the process is repeated for another geometry configuration. The simulations were carried out using a point source emitting a published Varian 15MeV x-ray spectrum at an SSD of 100cm, and for probability distributions with 5, 10 and 20 bins, with amplitude of movement or deformation in the order of 1cm. At the end of the simulation, the calculated dose arrays for each configuration are mapped onto a static reference configuration for display.

Results: when a comparison is made at selected points between the simulation for the reference configuration and the composite simulation, discrepancies on the order of 2% to 10% are found, with the larger differences seen at the edges of both the target and the critical structure.

Conclusions: the work here presented represents a first step towards fully modeling the movement of organs during the treatment planning process. Experimental verification of the results is underway.