AbstractID: 8343 Title: A new Monte Carlo code for Gamma Knife simulations

A new Monte Carlo code for Gamma Knife simulation

Purpose:
Gamma Knife is widely used in stereotactic radiosurgery (SRS) to treat brain tumors. In this study, a new Monte Carlo code was developed to simulate Gamma Knife system, which can be used to calculate Gamma Knife collimator factors, to verify Gamma Knife monthly and annual QA results and to evaluate treatment plan from Leksell GammaPlan system.

Method and Materials:
An EGSnrc based user code DOSIMETER was used for this study. The Cobalt-60 source and collimators were simulated based on their material, size and location in the system. Because of the equal geometries and materials of the sources and collimators, one source system is generated for all 201 sources in corresponded angle. For each collimator (4, 8, 14 or 18 mm), a phase space file was produced at the final helmet collimator surface. A CT image of a round QA phantom with 160 mm in diameter was introduced in the simulation system. Source linearity and profiles at isocenter were calculated using Monte Carlo simulations and compared with pin chamber and film measurement results. The relative collimator factors for 4, 8 and 14 mm were calculated and compared with ultra-thin TLD and OSL measurements. Finally, a plan from Leksell GammaPlan system was evaluated by the Monte Carlo simulations.

Results:
A Monte Carlo code was implemented for Gamma knife simulation. It showed good dose linearity. The profiles for each collimator were consistent with film measurements. The relative collimator factors from Monte Carlo simulations are 0.970, 0.938 and 0.873, which are within 3% against TLD and OSL results. The DVHs from Monte Carlo are in good agreement with GammaPlan system. The treatment plan dose difference at isocenter between Monte Carlo and the planning system is less than 1%.