

Purpose: To investigate the possible dose perturbation from head frame which is attached to patient skull to provide precise location of target in brain and is not considered during dose calculation in Gamma Knife SRS.

Method and Materials: An EGS4 based Monte Carlo simulation was applied to Gamma Knife SRS. In the simulation, the geometries of the stationary collimator and the helmet collimator were reconstructed exactly according to Gamma Knife Model C. The materials of the collimators were selected as close to the original materials as possible. All particles were traced through the stationary collimator and the helmet collimator until they pass the inner surface of the helmet or were absorbed. Patient's geometries were rebuilt from CT data. The dose was calculated using Monte Carlo simulation with and without presence of head frame using identical beam parameters. DVH was compared in a small volume around the iso-center.

Results: For patient's data, Monte Carlo results showed that although the 50% to 90% isodose lines remained almost the same with and without the presence of head frame, the maximum distance between two 10% isodose lines could be as far as 1.5 mm. The dose with head frame was about 1.3% lower than the dose without head frame. The dose difference varied from 1% to 2% among five patients.

Conclusion: The head frame may have significant impact on peripheral dose distribution as well as absolute dose. Since Automatic Positioning System is applied on Gamma Knife unit, average shot number for each patient has been increased to produce a conformal dose distribution to match the irregular tumor volume. Regular position check can't exclude the possibility that some shots are affected by the head frame. The dose perturbation from head frame should be considered in dose calculation.