AbstractID: 7602 Title: Monte-Carlo Calculation of Integral Dose for Gamma Knife Treatment Planning

Purpose: The ratio of Integral Dose (ID) has been found useful in support of DVH for Gammaknife (GK) treatment plan. A common ID calculation method is based on counting number of voxels within the target, but its accuracy is constrained by the grid size of the GK treatment planning system (TPS). The Monte-Carlo method is not only a macroscopic approach to calculate the dose distribution, but also can be used to calculate the ID of the tumor target and the critical structures with higher resolution – resulting in more accurate ID assessment. The purpose of this study was to apply a Monte-Carlo method to calculate the ID based on the analytical GK model. Furthermore, the ID of the plugged patterns, which improve the conformality of treatment plan, was evaluated by the Monte-Carlo method.

Method and Materials: A GK phantom model was used to calculate the dose distribution for the GK treatment plan. A C-shaped target with a central cylindrical critical normal tissue was created, and the critical region was expanded in different directions. The Monte-Carlo method was used to calculate the ID for differentially expanded critical regions. Blocking patterns of GK plans were optimized based on the ID of the critical regions.

Results: Three blocking patterns of the GK treatment plan were generated by 5mm expansion of the critical region. Using the ID calculated by Monte-Carlo method as an objective function, blocking pattern of each shot varies 10 to 20%, suggesting that blocking patterns are sensitive to the ID for the regions of interest.

Conclusion: Accurate ID calculation is feasible for GK plans with the Monte-Carlo method. Beam geometry information is included in the ID calculation, and the variation of critical regions can be reflected on the blocking patterns of the treatment plan. This concept can be expanded to other TPS.