AbstractID: 3289 Title: Comparison of Stochastic and Analytical Algorithms in Selecting Gamma Knife Plug Patterns for Treatment Planning

Purpose:

In gamma knife SRS, plugging pattern is often used to decrease dose to critical structure. Two algorithms have been developed and analyzed in this study. One is the stochastic plug selection based on simulated annealing algorithm; the other is the analytical approach based on greedy algorithm. Clinical cases were implemented to compare the efficiency of these two algorithms.

Method and Materials:

With the gamma knife analytical model, the target volume and the critical structure contours were extracted from the Leksell Gamma knife Plan. We used the integral dose to the critical structure as the objective function. This objective function is calculated by adding each plug's dose contribution to the structure. For simulated annealing algorithm, the energy term is the objective function, by randomly selecting blocked pattern from a randomly generated plugging pattern pool. By controlling iteration number, simulated annealing algorithm produced an optimal blocked pattern with optimal energy term. The greedy search approach also produced the optimal objective function value based on the dose contribution order from different plugs. The values from the objective function and the DVH are compared to show the performance of these two algorithms.

Results:

A number of different objective function values are computed via simulated annealing algorithm. We found that the objective function value is generally smaller than the objective function value attained by greedy approach. And the DVH also shows that simulated annealing algorithm gives less effective result to satisfy the criteria to deliver smaller dose to critical structure.

Conclusion:

The greedy approach produces an optimal blocked pattern in the first order with the objective function, and the solution is generally better than the simulated annealing algorithm. In addition, the simulated annealing algorithm demands long computational time and the more fluctuations in the final results.