

AbstractID: 13122 Title: Improving Gamma Knife plans using independent sector weighting

Abstract

Purpose: The Gamma Knife Perfexion uses 192 Co-60 sources divided into eight sectors. For each treatment isocenter, each sector can be either blocked or collimated using one of three collimator sizes, but the beam-on time is identical for all sectors. We postulated that independently variable sector weighting might confer dosimetric advantages with regard to critical structure sparing. In this work, we investigate the potential advantages of independently varying the weighting of individual source sectors to create sector modulated Gamma Knife (SMoG) plans.

Materials and Methods: We simulated independent sector weighting for a clinical Gamma Knife plan for a trigeminal neuralgia case. We first obtained dose matrices corresponding to the contribution of each sector. The sector weighting was varied in eight discrete levels and an optimum combination determined using an optimization algorithm. The resulting sector modulated Gamma Knife plan was then entered into the Gamma Knife treatment planning system by decomposing the weighted sectors into multiple shots at the same location with different weights and blocking. The process was repeated using four levels of sector weighting.

Results: Our results showed that the optimized plan reduced the maximum dose to the organ at risk (the brainstem) from 18.6 Gy to 11.8 Gy (with eight levels) compared to the clinical plan. However, the beam-on time for delivery increased from 32 minutes to 84 minutes. The SMoG plan with four sector weighting levels reduced the maximum brainstem dose to 12.6 Gy and only increased treatment beam-on time to 42 minutes.

Conclusions: We have demonstrated that independent weighting of the individual sectors in the Gamma Knife Perfexion can improve the quality of treatment plans, although at the cost of longer delivery times.