Cureus

Open Access
Abstract

Cureus

Hotspots: friend or foe? Effect on radionecrosis risk of penalizing high dose in linac SRS plans

Richard Popple ✉, John Fiveash

Corresponding author: Richard Popple

1. Medical Physics, University of Alabama at Birmingham 2. Radiation Oncology, University of Alabama at Birmingham

Categories: Medical Physics, Radiation Oncology
Keywords: treatment plannning, stereotactic radiosurgery, radionecrosis, volumetric modulated arc therapy (vmat)

How to cite this abstract
Popple R, Fiveash J (June 16, 2016) Hotspots: friend or foe? Effect on radionecrosis risk of penalizing high dose in linac SRS plans. Cureus 8(6): a61

Abstract

Objectives: Homogeneity is defined as the degree of uniformity of dose within a target. Many institutions include uniform dose in the target as a planning goal for linac-SRS brain metastasis treatments. At present, there is no convincing evidence of association between intra-tumor hotspots and increased toxicity. We hypothesized that explicitly enforcing homogeneity within intracranial SRS plans compromises other important aspects of plan quality, particularly spill of moderate isodose to surrounding normal tissue.

Methods: Ten multiple metastasis plans were identified that had been optimized with our previously published single-isocenter VMAT planning methodology that does not penalize hotspots within target volume and uses concentric shell based tuning structures to emphasize sharp dose fall-off outside the target. Each target was prescribed 18Gy. The plans were re-optimized with an additional objective that limited the maximum dose within the targets to less than 120%. No other parameters were changed. V50%, mean skull dose, and maximum target dose were compared between planning approaches. Because of our small sample size, a one-tailed Wilcoxon signed rank test was used at the 0.05 significance level.

Results: Because of our planning approach's emphasis on sharp falloff, of the ten plans, we were only able to successfully limit the maximum target dose to below 120% in six cases. In the original plans, maximum target dose ranged from 124.9% to 159.4%, and average maximum dose was 143.3%. In the plans re-optimized for target dose uniformity, maximum target dose ranged from 107.5% to 138%, and average maximum dose was 119%. Mean reduction of the of the maximum dose was 24.2%. Imposing a constraint on the maximum dose increased the V50% by an average of 6.53cc ($p = 0.002$) without a decrease to mean skull dose ($p=0.21$).We did not observe a change in conformity.

Conclusions: Treatment planning strategies that explicitly enforce homogeneity will produce inferior radiosurgery plans. Specifically, we found hotspot penalization increased V50% with no coincident benefit to other aspects of plan quality. Therefore, enforcing target dose uniformity may increase, rather than decrease, the risk of toxicity.

Open Access
Abstract
Published 06/16/2016