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Abstract

Quantitative Effects of Surgical Resection in Stereotactic Radiosurgery (SRS) for Brain Metastasis

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Objectives: The two options often considered for treatment of brain metastases are a course of noninvasive radiation therapy with Stereotactic Radiosurgery (SRS) or a course of surgical resection followed by radiation therapy to the surgical resection cavity (Post-Op). From the physician's perspective, the latter treatment course is often chosen based on the tacit concept that the therapeutic ratio is enhanced by reducing the required tumor volume and, thereby, improving the efficacy of the treatment. Though the concept seems sound, this resection-benefit in terms of treatment parameters and the normal brain remains to be validated. This study aims to retrospectively compare the plan parameters of SRS plans delivered to intact brain metastases and plans delivered to the tumor beds from which the brain metastases were resected. Our objective was to outline the differences in planning parameters and impact on the normal brain between the two treatment options.

Methods: 45 patients previously treated with stereotactic radiation therapy to a tumor bed of a resected brain metastasis were selected for this retrospective analysis. Each patient underwent volumetric imaging before brain surgery. These images were used to create SRS plans imitating how the tumor would be treated with radiation therapy alone, without surgical resection. The differences in target volume and various normal tissue dose-volume statistics were analyzed to compare the differences in planning parameters between the Post-Op and the hypothetical non-resection radiation treatment course.

Results: Comparisons of dose-volume statistics and Planning Target Volume (PTV) size between the two viable courses did not show decreases in Post-Op PTV volumes, mean normal tissue doses nor discrepancies in dose indexes. Overall, the median PTV volume difference between the two courses was found to be about 2 cc, with the Post-Op PTV being larger than the unresected PTV. Furthermore, the mean doses to critical structures (Brainstem, Optic Chiasm, Left and Right Hippocampus) and dose indexes (Conformity and Gradient index) were found to be negligible for the overall cohort but significant for individual cases; most individual cases clearly had structures receiving larger mean dose or plans with larger dose indexes in either the unresected or Post-Op treatment based on the location of the treatment site. The PTV, mean dose, and dose index differences found between the two courses were evaluated to be statistically nonexistent by two-sided-hypothesis significance tests (alpha a = 0.025). Though the case, the increase of the Post-Op V10Gy, V12Gy, and V14Gy by approximately 10 cc relative

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to those of the unresected course were evaluated to be statistically significant.

Conclusions: This study found there would be an approximate 2 cc decrease in the PTV volume if the brain lesions had been treated via SRS alone rather than through the Post-Op course, though the non-resection SRS course would not necessarily translate into an overall decrease in mean dose to critical structures because the doses to these structures were insignificant. While these specific findings lack statistical authority at this current time, other findings of this study suggest a statistically significant decrease of the V10Gy, V12Gy, and V14Gy in the non-resection SRS course relative to those of the Post-Op course.