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Abstract

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A Preplan Prediction Tool to determine V12 Normal Brain Dose from Gamma Knife Plan Parameters

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Abstract

Objective: A tool was created to help estimate the necessary Gamma Knife parameters needed in order to maintain the V12 normal brain tolerance dose. This tool can be used before the planning session has started and can help guide the necessity of creating optimal conformal plans and perhaps faster dose fall off. This can also be an advantageous tool to use in preplanning sessions. Finally, it can be used to help set the optimization parameters used inside the Leksell Gamma Plan treatment planning system.

Methods: Tables were created by calculating from the initial tumor volume, plan coverage, the plan selectivity, and the gradient index and estimating the volume of the prescription and the 50% prescription doses. The plan coverage is defined as the proportion of target volume that is covered by the prescription isodose volume. The plan selectivity is defined as the proportion of the prescription volume that is inside the target volume. The gradient index is defined as the quotient of the 50% prescription dose volume and the prescription isodose volume. From these values, the V12Gy dose was then determined. To use these tables, one would take the initial target volume, determine the prescription dose to be used, and from the tables look up the necessary selectivity and gradient index that would be needed to keep the plan below the V12Gy normal brain dose.

Results: Comparisons were made with perfect sphere shapes of a particular volume. Predictions for these were very accurate and was agreement with the predicted V12Gy normal brain dose was good between the predicted and the calculated dose determined in the Leksell Gamma Plan system. Additional comparisons were made between plans with actual patient anatomy and with the prediction tool were also in good agreement. The exception of course was seen when the surrounding tissue was not necessarily brain tissue, such as skull or sinus areas. More deviation in the results were seen in the more complex shaped lesions.

Conclusion: A tool was successively made that could help guide Leksell Gamma Knife planning and limit the amount of dose to the normal brain tissue to its tolerance dose. This tool could be on the day of planning or as a preplanning tool prior to the patient's treatment. Limitations for the tool were highly complex shaped lesions and those that were adjacent to non-normal brain tissue regions.