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Research Article

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[Biological dose calculation using variable RBE in Single- and Multi-field Optimization IMPT plans for 3 Brain Tumor patients](#)

**Purpose:** The purpose of this study was to evaluate biological dose in single-field optimization (SFO) and multi-field optimization (MFO) intensity-modulated proton therapy (IMPT) plans for brain tumor patients that used a fixed relative biological effectiveness (FRBE) and those that used a variable RBE (VRBE).

**Materials and methods:** SFO and MFO IMPT plans were planned by the Varian Eclipse treatment planning system for three brain tumor patients. Dose and linear energy transfer (LET) distributions for each plan were recomputed using an in-house fast Monte Carlo dose calculator system, and then biological dose distributions were calculated with a FRBE of 1.1 or with a previously published VRBE model. We then compared biological dose distributions obtained by the VRBE with those obtained by the FRBE.

**Results:** Doses obtained by the VRBE for the gross tumor volume and clinical target volume in all plans were 1%-2% larger than those obtained by the FRBE. The minimum dose obtained by the VRBE for the brainstem in the SFO IMPT of one patient was 140% larger than that obtained by the FRBE, but the difference was only 5.3 cGy (RBE). The difference in maximum dose for the optic chiasm in the MFO IMPT of another patient was less than 3.2%, but the dose difference was 149.2 cGy (RBE). We also found that no major differences were seen between the biological dose differences in the SFO IMPT plans and those in the MFO IMPT plans.

**Conclusion:** We could observe biological dose differences between the FRBE and the VRBE in the SFO and the MFO IMPT plans for brain tumor patients.

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