THE EFFECT OF UNCERTAINTY IN "FIELD OF THE DAY" TREATMENT REGIMES IN PROTON THERAPY

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ABSTRACT

The aim of this study is to analyze how uncertainties impact the quality of proton therapy treatment when a rotating subset of the planned fields is delivered for each fraction rather than delivering all planned fields for every fraction.

Uncertainties were separated into two categories, physical and biological. Physical uncertainties were analyzed by introducing a physical uncertainty into a treatment plan and comparing resulting dose calculated for different treatment regimes. Biological uncertainties were analyzed using models that have been proposed in the literature. Comparisons were made for different treatment regimes.

Physical errors in a single field of a plan are partially mitigated when multiple fields are delivered for each fraction. The effects of biological uncertainties due to differences in fractionation are very similar to the effects of hypofractionation used in radiosurgery. This results in increased biological effect in normal tissue for the same dose when fewer fields were delivered for each fraction. The LET-dependence of the proton RBE primarily impacts the target region of the patient. For parallel opposed fields the increased uniformity of the two-field per fraction treatment resulted in a RBE advantage compared to the one field per fraction treatment.

Uncertainty due to fractionation differences for different delivery regimes had the greatest impact on the overall treatment.