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Impacting Parameter Analysis for Intensity Modulated Radiation Treatment

Huanmei Wu

Computer, Information, and Leadership Technology, Indiana University Purdue University Indianapolis, Indianapolis, IN 46202

Abstract

Introduction: Intensity-modulated radiation therapy (IMRT) accurately delivers radiation doses with high degree of conformity by modulating the intensity of the radiation beam in multiple small segments. Usually small fields have large variation in dose. For some TPS, there are no restrictions on plan parameters. Guideline for plan optimization is needed that allows the IMRT QA to pass satisfactorily. IMRT plan parameters are analyzed to correlate the success and failure of an IMRT QA plan.

Materials and Methods: Based on IMRT QA results, 15 IMRT treatment plans, divided into 3 groups, are studies. Plans in group 1 passed IMRT QA with high gamma index passing rates and plan in group 2 passed with marginal passing rates. Plans in group 3 failed the IMRT QA. Statistical analysis has been performed on plan parameters, including beam number, segment number for each beam, MU in total or for each segment, the width variations of the leaf/jaw positions for each segment, the segment area sizes, and dose delivery for different segments of each beam, to discover the relationships between IMRT quality and these parameters.

Results: The statistical results showed there is no correlation between plan quality and MU or beam/segment numbers. However, there are noticeable correlations between the IMRT quality and the segment sizes and widths. For each plan group, the IMRT quality decreased with the decreasing field sizes and segment widths. The histograms of these factors showed that failed IMRT plans have peak distributions with small field sizes ($< {}^{30cm2}$) and narrow widths (<20mm).

Conclusion: Initial results showed that the passing rates of IMRT treatment plans have strong correlation with the segment field sizes and the opening widths of the leaf/jaw positions. Large number of segments with small fields produces unacceptable IMRT QA and should be avoided during IMRT planning.