

Effect of Modulation Factors on Tomotherapy Plans and Their Quality Analysis

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Abstract : This study was aimed at investigating quality assurance (QA) done with IBA matrix, the discrepancies observed for helical tomotherapy plans. A selection of tomotherapy plans that initially failed the with Matrix process was chosen for this investigation. These plans failed the fluence analysis as assessed using gamma criteria (3%, 3 mm). Each of these plans was modified (keeping the planning constraints the same), beamlets rebatched and reoptimized. By increasing and decreasing the modulation factor, the fluence in a circumferential plane as measured with a diode array was assessed. A subset of these plans was investigated using varied pitch values. Factors for each plan that were examined were point doses, fluences, leaf opening times, planned leaf sinograms, and uniformity indices. In order to ensure that the treatment constraints remained the same, the dose-volume histograms (DVHs) of all the modulated plans were compared to the original plan. It was observed that a large increase in the modulation factor did not significantly improve DVH uniformity, but reduced the gamma analysis pass rate. This also increased the treatment delivery time by slowing down the gantry rotation speed which then increases the maximum to mean non-zero leaf open time ratio. Increasing and decreasing the pitch value did not substantially change treatment time, but the delivery accuracy was adversely affected. This may be due to many other factors, such as the complexity of the treatment plan and site. Patient sites included in this study were head and neck, breast, abdomen. The impact of leaf timing inaccuracies on plans was greater with higher modulation factors. Point-dose measurements were seen to be less susceptible to changes in pitch and modulation factors. The initial modulation factor used by the optimizer, such that the TPS generated 'actual' modulation factor within the range of 1.4 to 2.5, resulted in an improved deliverable plan.

Keywords : dose volume histogram, modulation factor, IBA matrix, tomotherapy

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