The Dosimetric Accuracy of Two Treatment Planning Systems for Step-and-Shoot Intensity Modulation

Although most three-dimensional radiation treatment planning (3D-RTP) systems have been evaluated and determined to be dosimetrically accurate for conventional radiotherapy, these systems are frequently being used to calculate small field step-and-shoot segments for intensity modulated radiotherapy (IMRT). However, few of these systems contain beam-modeling parameters, or curve fitting data similar to those encountered during IMRT. This study was undertaken to evaluate the dosimetric accuracy of two existing commercially available 3D-RTP systems (ADAC Pinnacle 4.0e and Varian CadPlan 3.12) for step-and-shoot intensity modulation.

Dosimetric measurements were taken on a Varian 2100 C/D equipped with a 52-leaf multileaf collimator (MLC). The dosimetric accuracy of the IMRT test plans were evaluated by the direct measurement of dose using a linear 46 diode array (Sun Nuclear Profiler) and a parallel-plate ionization chamber. To verify the dosimetric accuracy of the small MLC segments, measurements were made using the Profiler placed at depth in solid water. Various profiles were measured (both on and off the central axis) and compared to the calculated dose distributions in a water phantom.

The measured and predicted doses for both treatment planning systems were found to agree within ±3% at all points except for high gradient regions, which is within clinically acceptable limits. These results indicate that the ADAC Pinnacle and Varian CadPlan 3D-RTP systems have the potential to generate dosimetrically accurate IMRT treatment plans without special beam modeling.