DOSIMETRIC VERIFICATION OF RADIOTHERAPY TREATMENT PLANNING SYSTEM USING THORAX PHANTOM

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Background: Quality Assurance (QA) in radiotherapy treatment planning process is essential to ensure that the dose calculation is performed correctly and to minimize the possibility of accidental exposure. Reduction of errors and uncertainties plays an important role in the outcome of radiotherapy treatment. Based on clinical dose-response curves, the overall accuracy of the dose delivery should be less than 5% [1–3]. In order to achieve that goal a number of task groups over the past several years have developed guidelines and protocols for systematic QA of radiotherapy treatment planning systems (TPSs) [4,5]. The purpose of this study is to verify the Treatment Planning System (TPS) i.e. to verify the Hounsfield units (HU) to relative electron density (RED) conversion curve stored in the TPSs and hence to observe the range of deviations between planned and delivered doses.

Materials and Methods: The study was conducted in the radiotherapy departments of Delta Hospital Ltd., using Linac (True Beam, Varian). An anthropomorphic phantom (CIRS Thorax, Model 002LFC) was scanned twice with a computed tomography unit (SIEMENS, Somatom) and treatment plans for seven different test cases involving various beam configurations suggested by the IAEA TECDOC 1583 were prepared on local treatment planning systems (TPSs). The phantom was irradiated following the treatment plans for these test cases and doses in specific points were measured with an ionization chamber (FC-65P) and and DOSE 1 Reference Class Electrometer (IBA). The differences between the measured and calculated doses were reported.

Results: The deviation between the measured and calculated values for all test cases were made with advanced algorithms within the agreement criteria, while the larger deviations have been observed for simpler algorithms. All systems reviewed in this study had generic or TPS manufacturer supplied CT to RED conversion curves. Based on the measurements, we concluded that there were differences of 6-12% in the region of higher electron densities. The acceptance criteria for the difference between the stored and measured values of CT numbers for the same RED were ±20HU. However, it was estimated that this difference in relative electron density affects dose calculation accuracy ~3% (2-3%).

Conclusion: This research helped the users to better understand the operational features and limitations of their TPSs and resulted in increased confidence in dose calculation accuracy using TPSs.

Future Plan: To verify the TPS and to observe the range of deviations between planned and delivered doses of all radiotherapy centers in Bangladesh and hence to make an inter-comparison between them.

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