

INTRA-INSTITUTIONAL END TO END TESTING ACCURACY OF MODERN TECHNOLOGIES AND TECHNIQUES IN RADIOTHERAPY

Abstract

Objective: Intensity Modulated Radiation Therapy (IMRT) treatment techniques have evolved and the current level of interest in IMRT warrants a determination of the accuracy in delivering IMRT, in multiple institutions practicing IMRT. The aim of this study was to (a) perform in-phantom end to end testing accuracy of 3D-Conformal Radiation Therapy (CRT) and different IMRT techniques, (b) check the dosimetric impact of dose delivered with deliberate offsets in the physical positioning of the phantoms using Cone-Beam Computed tomography (CBCT) and (c) use CBCT based IGRT to establish the extrinsic setup errors achieved between set-up and delivery of the planned dose on phantoms. **Materials and Method:** Studies were conducted in 3 institutions. An anthropomorphic phantom and a MatriXX^{Evolution} with MULTICube were CT-scanned and the CT slices were transferred to the treatment planning systems (TPSs). The transferred CT-slices were used to create a patient model and plans were created on hypothetical targets situated adjacent to an organ at risk (OAR). A virtual water phantom was also created in the same TPS and the same plans were created for verification purposes. The plans were transferred to a linear accelerator using a record and verify network system. The phantoms were positioned on the treatment couch and the dose delivered according to the treatment planning protocol. Statistical tools were used to analyse the delivered dose to the planned dose. **Results and discussion:** The end to end testing per institution was found to be less than 5% for dynamic IMRT and 2% for 3D-CRT when comparing planned to the measured dose. Comparison between institutions resulted in less than 7% dose difference for dynamic IMRT and 2% difference for 3D-CRT. Phantom setup errors were found to be less than 6 mm, 4 mm and 3 mm for the pre-treatment, post-correction and post-delivery setups respectively. The dose difference delivered with a deliberate 3mm setup error was found to be less than 1%, 3% and 4% for the Catphan®, Pelvis and Head and Neck plans respectively. **Conclusion:** The overall accuracy of the treatment techniques at each institution was determined successfully. Independent phantom setups are likely to indicate the best possible setup precision as they are much easier to setup reproducibly than a patient with an internal margin for involuntary movement. Pre-treatment imaging was able to detect setup errors of 6 mm in Pelvis cases. Head and neck treatments delivered with advanced techniques are the most sensitive dosimetrically to small setup errors.