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Quality Assurance of Inhomogeneity Correction Algorithm in the Intensity Modulated Radiotherapy and Dynamic Conformal Arc Radiotherapy Using Multiple Heterogeneous Head and Neck Phantoms

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Purpose: The inclusion of heterogeneous media in the treatment fields of high-energy radiotherapy creates a potential dosimetric problem due to the loss of charged particle equilibrium in tissues near the heterogeneous interfaces. To quantify the differences between heterogeneous dose estimates from the calculation algorithm of 3-D treatment planning systems and dosimetry measurements, radiation was delivered in accordance with IMRT and conformal dynamic arc radiotherapy (CDART) QC procedures using multiple heterogeneous head & neck phantoms.

Method and Materials: The multiple inhomogeneous head and neck phantoms were constructed by various materials such as water equivalent homogeneous (acryl), air equivalent (cavity), bone equivalent (teflon) materials. The absolute and relative dosimetry were done using pinpoint ionization chamber, film and TLD (Harshaw 100). With custom-written software modules, the measured and calculated dose distributions were superimposed and compared.

Results: The point dose measured at the interface between water and air material region shows about 7 % mismatch with the treatment planning system in IMRT. This dose difference is even increased at the interface between bone and water material region reaches up to 18 % under-dose comparative to planned value. However, the point dose error at the interface between water and bone material region is relatively small showing about 3.2% over-dose. In CDART, the distribution verification result shows that there is a mismatch of about 1.5 % of whole points revealing more than 5% of the dose difference between measured values and planning value when the inhomoheneious phantoms are used. Our results suggest that the effectiveness of the imhomogeneity corrections used in IMRT and CDART planning should be evaluated to ensure meaningful quality assurance and delivery.

Conclusion: The robustness of inhomogeneity correction used in IMRT and CDART treatment planning may be a significant factor in assuring predictable, accurate delivery of IMRT.

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Keywords : Inhomogeniety, Head and Neck Phantom, Confor-mal Dynamic Arc Radiotherapy