Reliability and use of the HiArt detector for 3D dose reconstruction in tomotherapy

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Introduction

The HiArt built-in detector of the tomotherapy is used for patient imaging, but it also records the transmitted dose during the entire treatment. Our aim was to determine whether the Xenon-filled ion chambers of the detector are reliable for 3D dose reconstruction and whether a calibration of the signal is possible.

Materials and Methods

The transmitted signal on the detector was extracted from the built-in detector using the TQA (tomotherapy quality assurance) tools. A calibration of the signal was done using an independent measure with the A1SL ion chamber and gafchromic films. Short term, i.e. on a typical treatment time scale, and long term stability of the signal was checked by measurements over 2 months. The variability with beam hardening and scatter amount was also checked. To reconstruct the delivered dose to a solid water phantom an iteration algorithm was used. This algorithm, presented at the SSRPM 2007 meeting, was upgraded by using 3D Monte Carlo simulated energy deposition kernels. The dose reconstruction was performed for different MLC configurations.

Results

Our measurements showed that the Xenon-filled chambers are reliable for the measurement of the transmitted beam on a long term basis, i.e. the variations from day to day was under 1%. The transmitted signal could be converted into a dose using independent measurements. The iterative algorithm estimated the delivered energy fluence and the 3D dose distribution was computed with a precision within 3%/3mm.

Discussion

The signal measured on the Xenon-filled ion chambers is reliable on a long term basis and a conversion into a dose could be done. The dose delivered to a solid water phantom could be reconstructed with a satisfying precision for the check of the delivered dose. This is a first step for adaptive radiotherapy.