

On the impact of treatment couch modeling on rapidarc

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Introduction

A planning and dosimetric study was carried out on a cohort of six CT dataset from patients treated for prostate cancer to assess the impact of couch modelling on accuracy of dose calculation for the volumetric modulated arc technique RapidArc.

Material and Methods

For each patient RapidArc plans were optimised using the couch while final dose calculation was performed with different conditions (thin, medium, thick and no couch). Analysis was performed in terms of dose volume histograms, dose difference histograms and 3D-g tests. Pre-treatment verification measurements were performed using the PTW 729 array in conjunction to the Octavius phantom; similarly, HU characterisation of couch was performed with the same phantom and ion chamber measurements comparing calculations and experimental data.

Results

A set of HU valid for low and high energy and the entire couch length was found as: internal structure HU=-960, surface shell HU=-700. Analysis of dose plans showed that differences larger than 1.5 Gy might be observed on significant fractions of PTVs (more than 30% at low energy, 5% at high energy) when the couch is either modelled or not in the dose calculation. Smaller differences are visible in the medium low dose regions. 3D-g evaluation showed that these differences are not recoverable within 3% or 3mm thresholds leading to gamma agreement index (GAI) as low as 85% in the high dose PTV for 6MV. Pre-treatment verification on composite delivery confirmed these observations and, at the same time, showed a good accuracy of dose calculations in the presence of couch modelling compared to delivery in the same conditions (GAI ranging from 95% to 100%).

Discussion

Results, globally confirmed that the geometrical model build-in the planning system Eclipse is reliable and: i) there is no measurable effect if the wrong segment of the couch is used in the calculations ii) there are significant and of potential clinical impact discrepancies at the level of the target volumes if calculations are performed without couch and delivery is performed with couch; iii) the effect is particularly relevant at low energy (6 MV in this case) that is the configuration clinically used by most of the centres adopting IMAT or VMAT technologies.

References

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