The effect of different table top models on the agreement between calculations and measurements on the Delta4 phantom

Paelinck L, Wuyts E, Vanderstraeten B, De Wagter C, Lievens Y
Radiotherapy, Ghent University Hospital, Belgium

Purpose

The purpose of this study was to investigate the effect of different table top models on the agreement between calculations and measurements on the Delta4 phantom (Scandidos) for different beam configurations. Also, 8 full arc prostate plans were measured and compared with calculations without the table model and with the three different table models included.

Materials and methods

Our Elekta linear accelerators are equipped with the iBeam evo carbon fiber table top. Three different models for this table were considered in our TPS RayStation 6 (RaySearch): a CT-based, a simple and an advanced geometric model.

For the CT-based model the treatment table was removed from the linear accelerator and scanned with a Toshiba Aquilion LB CT simulator. Thereafter, the part of the CT-images where the table-pixels are located, were extracted and injected in the artificial CT-images of the Delta4 phantom with a home-made java program. The result of this operation is seen in fig 1a.

The simple geometric model is represented by a slab with a density of 0.25 g/cm³ (fig 1b).

The advanced geometric model is represented by a thin outer surface layer mimicking the table contour composed of carbon fiber (1.18 g/cm³) and an inner core composed of foam (0.055 g/cm³) (fig 1c).

Different beam configurations of 3x3 cm², 5x5 cm² and 10x10 cm² at angles of 0°, 140°, 160° and 180° as well as a half arc of 180° crossing the table and a full arc of 360° for 6 and 15 MV were measured and calculated on the Delta4 phantom without and with the three table models included. The same was done for the 8 full arc prostate plans. All measurements were performed on the same day and a proper daily correction factor was applied. For the analysis of the prostate plans, a gamma criterion of 3%/3mm was used.

Results

The percentage difference between measurements and calculations in the centre (at isocentre) of the Delta4 phantom is shown in figure 2 for 10 x 10 cm² field configurations both for 6 MV and 15 MV. Graphs for the other investigated field sizes are similar.

The percentage differences for the CT-based and simple model are fluctuating around zero, whereas the percentage differences without table and with the advanced table model are all either negative or positive and have a larger range. This means that the CT-based and simple table model are equivalent to each other and superior to the others.

Gamma analysis of the prostate plans shows little variances between the different models. This can be declared by the observation in figure 2 that the differences between measurements and calculations are below 1% for full arcs.

Conclusions

The quality of the simple model and the CT-based model are equivalent. It is surprising that the quality of the advanced model is not satisfying. We prefer to use the simple model in routine clinical practice since it is more user-friendly than the CT-based model.