

Absorption measurements for a carbon fibre couch top and its modelling in a treatment planning system

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Introduction

Full carbon couch tops are widely used for radiotherapy treatments on linear accelerators. In contrast to their predecessors which were constructed with metal bars they have almost no limitations in choosing beam angles in treatment planning. In this work we have measured the absorption for the new Varian Exact IGRT couch top[®] for different setups. With the latest version of our treatment planning system (TPS), it is possible to model the couch top as a supporting structure with different options for parameter settings. We investigated the quality of the modelling of the couch top in the TPS and the influence on clinical dose distributions were analysed.

Material and Methods

The couch top, of which the surface consists of carbon fibre and which is filled with foam [1], was CT-scanned (120 kV) together with the phantom setup used for dose measurement. Within the TPS (Eclipse V 8.6) a model of the couch top was added as a structure to the CT slices and was included in the dose calculation. The 3 different predefined thicknesses of the couch top model, thin (50 mm), thick (75 mm) or medium (62.5 mm) were added and evaluated. For absorption measurement we irradiated a cylindrical, isocentrically placed PMMA phantom (diameter 20 cm, length 12 cm) varying gantry angle, photon energy (6, 15 MV), field size (4 cm, 10 cm) and position at the couch top (thin and thick part). By defining HU values for the couch top surface and the inner material of the couch top the model has been fitted to the measurement. We compared the farmer chamber measurement to the TPS dose calculation with the original scanned couch top and with the couch top model.

Results

For a 10x10 cm² field we measured the following absorption for gantry angles of 180° and 115° (worst case, intersection with the edge of the panel):

Absorption photon energy\gantry angle	thin part		thick part	
	180°	115°	180°	115°
6 MV	2%	3.5%	3%	4.5%
15 MV	1%	2.5%	2%	3.5%

For a 4x4 cm² the absorption is roughly 0.3% higher than for the 10x10 cm² field. The outline of the Eclipse couch top model and the real couch top are nearly identical in transversal projection. The passage from the thin to the thick part is approximated with the medium thickness. By taking HU = - 680 for the carbon surface and HU = - 950 for the foam of the couch top the agreement between measurement and calculations is within 1%. For clinical situations, where the lateral couch position is variable (e.g. prostate), the deviation may be larger because the dorso-lateral fields are passing through the couch only partially.

Discussion

Advantages of the couch top are the stiff material consisting of only two components and the low absorption. The different thicknesses and the 35 cm long passage from the thin to the thick part of the couch top may be a disadvantage. An advantage of the Eclipse couch top model is the possibility to adapt the Hounsfield Units of the surface and the inner material. As in some clinical situations, the treated volume is located in the transition zone between thick and thin end (e.g. H&N), the model is only an approximation. For a higher precision, exact modelling of the couch top and absolute indexing of the patient position on the couch top in lateral and longitudinal direction would be necessary.

References

[1] Exact IGRT Couch, User and Maintenance Guide, Varian Medical Systems, P/N 100026454-14, Dec. 2008