Purpose:

The delivery of the therapeutic radiation dose to the tumour in photon radiotherapy, also implies dose deposition in distant organs (peripheral dose) related to secondary cancers induction (Hall and Wuu, Int J Radiat Oncol Biol Phys 56:83-88, 2003). Therefore, peripheral dose estimation in MU-demanding techniques, such as Helical TomoTherapy (HT), becomes relevant. TLD measurements and Monte Carlo modelling were compared by D'Agostino (Strahlenther Onkol 187:693, 2011). The purpose of this work was to find out experimental models predicting the equivalent photon dose as a function of the distance to the isocenter for different treatment types. The prostate case is presented here.

Methods:

A HT prostate plan was delivered to an anthropomorphic phantom mimicking a male adult. The phantom was made of polyethylene blocks whereas light wood was used for lungs. 16 points distributed along the phantom, covering different depths, were selected (Sánchez-Doblado IFMBE, World Congress Med Phys & Biomed Eng, 259-261, 2009). Additionally, a polyethylene sheet was inserted in the phantom to measure the off-axis dose profile at midplane depth. Measurements were carried out with standard TLD-100 pairs of dosimeters (calibrated in a 137Cs source).

Results:

Two-exponential-terms curve fitting was carried out to model separately the scatter and leakage contribution ($f=a\cdot\exp(-b\cdot x)+c\cdot\exp(-d\cdot x)$). The former resulted predominant in the proximal region ($10\%\leq x \leq 14$cm) and the latter in the distal region ($x \geq 14$cm). Both components equate at 18cm. Scatter contribution becomes negligible for $x \geq 23$cm. Points at 5cm were not used for the model as they are too close to the isocenter to be considered as peripheral dose. Model fits well experimental data (13% mean deviation). Only depths behind the build-up region could be properly modelled.

Conclusions: Peripheral photon dose profiles in HT treatments have been modelled by a two-exponential-terms curve modelling separately scatter and leakage.