The dose calculation based on CBCT-images for long target cases: a phantom study

A. Lisovskaya[1], A. Loginova[1], A. Nechesnyuk[1], V. Belyaev[2]
[1]Dmitry Rogachev National Medical Research Center Of Pediatric Hematology, Oncology and Immunology, Radiotherapy Department, Moscow, Russia
[2]National Research Nuclear University MEPHI, Institute of Engineering Physics for Biomedicine, Moscow, Russia

Background and purpose. Cone-Beam Computed Tomography (CBCT) images have different normalization of the Hounsfield Units (HU), artifacts and a limited field of view. That is all creates difficulties for the CBCT dose recalculation. In this study we assess the possibility of using several CBCT sets for replanning or further dose evaluation for long target cases.

Methods. Doses were calculated in the anthropomorphic phantom CIRS ATOM ® using Monte-Carlo algorithm in MIM SureCalc® MonteCarlo (Cleveland, USA). Planned dose at the CT images (rCT) was considered as reference, doses at different CBCT images were considered as evaluated. The phantom was scanned with the standard CT mode (120 kV); the targets (Brain and Spinal Cord) were contoured and treatment plan was created.

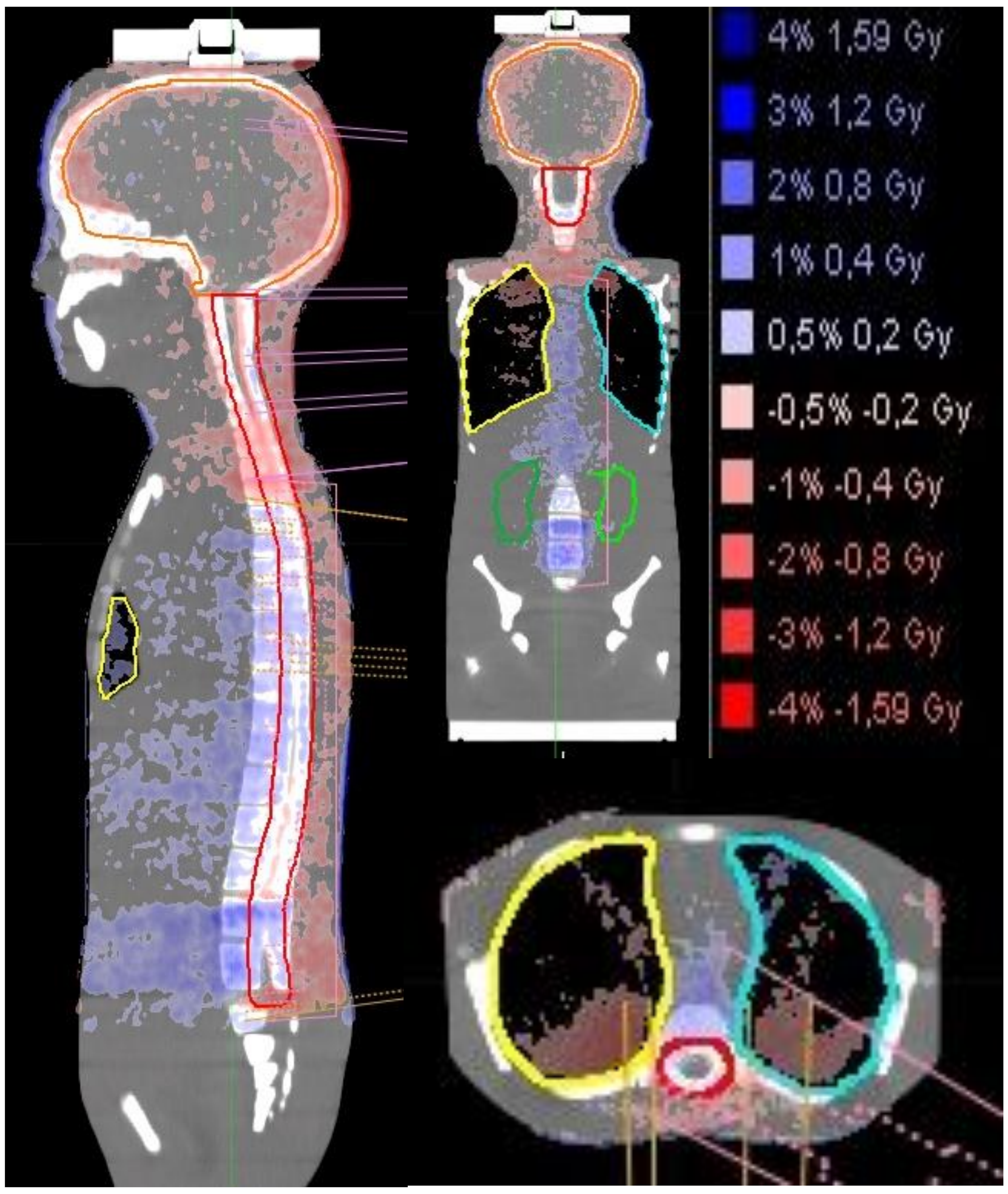

Fig.1 *Dose difference between rCT and cCBCT with imbedded HUs correction*

Results. Obtained CBCTs for four different regions of the phantom (head, chest, abdomen, and pelvis) were united into one combined series (cCBCT) for futher dose calculation. Also all areas were scanned using the only low-dose CBCT protocol to get another low-dose cCBCT. HU to electron density correction was applied for both cCBCT and low-dose cCBCT, assigning density to bones and lungs was applied only for low-dose cCBCT. Reference and evaluated dose distributions were compared using gamma criteria of 2 % 1 mm. The number of points that satisfy this gamma-criterion is 87.38 % between rCT and low-dose cCBCT; 94.08 % between rCT and low-dose cCBCT with assign lungs and bones densities; 96.78 % between rCT and low-dose cCBCT with imbedded correction HUs; 98.72 % between rCT and cCBCT captured on different protocols corresponding scan areas with imbedded HUs correction.

Conclusion. Plans recalculation using several CBCTs for long targets is difficult but feasible task and provide possibilities for adaptive radiotherapy.