Photon dose calculation performances of a 3D treatment planning system compared to the Monte Carlo code "BEAM".

The purpose of this work is the comparison of the photon dose calculation performances of a commercially available 3D treatment planning system (ADAC Pinnacle[3] v. 4.0e) against BEAM, a Monte Carlo reference code that allows a detailed simulation of a radiotherapy accelerator. The first part of the work is devoted to the benchmarking of BEAM for 6 MV photons and to the optimization of the linac description (SIEMENS Mevatron M6700) to fit the experimental data. The second part takes into account the calculation in virtual phantoms built to simulate electronic non-equilibrium conditions. The third part shows the comparison between the codes working on real patient's CT data sets: a mediastinal treatment and a breast treatment have been simulated. All dose results are given in absolute values; with BEAM, these were obtained reproducing the linac calibration setup.

The results on virtual phantoms show that the 3D algorithm approaches the MC computations in situations of electronic non-equilibrium along the beam direction, while it can fail in situations of lateral electronic non-equilibrium. This is probably due to the approximation used in the collapsed cone convolution algorithm.

For the real patients comparison, differences between Pinnacle[3] and BEAM up to 5.7% are observed for the total dose calculated at the prescription point. Single field analysis shows that the differences increase with increasing depths and where the effective depth is significantly shorter than the geometrical one.