Purpose:

The accuracy of dose calculation in CT data sets derived from a linac attached kV-cone beam CT (kV-CBCT) equipment was analyzed by comparing dose profiles, depth dose curves, and dose volume histograms of scanned objects with the dose parameters calculated in the respective fan beam CT cubes.

Method and Materials:

To perform kV-CBCT acquisition for adaptive radiotherapy an x-ray tube and a flat panel imaging detector were attached at a linac on opposing sides of the isocenter. Several phantoms, namely a water filled cylindrical phantom, a special contrast phantom with several inlays of different materials, and an Alderson head phantom were scanned. Furthermore a kV-CBCT was performed for a real head and neck patient with the intention to correct for patient setup-errors. The data were reconstructed with an in-house software tool not executing any scatter corrections. Dose distributions were calculated using a clinically approved pencil beam algorithm for modulated or actual treatment plans. Attenuation coefficient to electron density conversion for kV-CBCT dose calculation was done with help of the contrast phantom using a simple calibration procedure. Dose contours and DVHs were compared to reference calculations on fan beam CT data. Additionally a γ-criteria analysis was performed.

Results:

For all analyzed cases absolute dose values and DVHs calculated on the CBCT data sets were in good agreement with the reference data and no differences greater than 3% were found in the considered profiles. Therefore the comparisons also passed the 3% and 3mm γ-criteria in nearly all voxels.

Conclusion:

Although CBCTs may hardly be comparable in image quality to standard diagnostic ones they might nevertheless be good enough for a sufficiently accurate dose calculation and therefore be well suited for dose guided radiotherapy. Even better results may be possible by additionally including scatter correction.

Conflict of Interest: