Purpose: The tomotherapy MVCT images should in theory allow offline adaptive treatment monitoring by recalculation of the dose on each day's image and summation over the entire treatment course. However, Instabilities in the MVCT-beam can cause shifts in the calculated doses because of shifts in the HU-calibration (Duchateau et al,2010 Phys. Med. Biol. 55). However, the significance of these shifts can only be established by performing the recalculation again using a newly acquired hu-calibration curve using a density phantom or patient specific datapoints. This work aims in defining a clear threshold using simple image parameters such as mean HU shift and noise level on the image. This also allows to devise a strict QA program for the MVCT beam based on image quality, which can be accessed in a simple manner, as opposed to beam characteristics, which require service interventions.
Methods: Simple spherical phantom-images were created in dicom-format with a mean HU-value representing air, bone , fat , lung and muscle with no superposed noise (baseline set). This set was altered by a)shifting the mean HU and b)superimposing Gaussian noise-levels of up to 30% (clinical observation). The dose was planned on the baseline set and recalculated on the other sets using the tomotherapy DQA-software.
Results: Results show a deviation of 2% in dose for a 30HU-shift in the water-like region (fat, muscle) and a much lower sensitivity for the high and low densities(air,bone, lung) of about 0.5%. Noise levels had no influence on the center of the sphere when levels were below 20%.
Conclusions: It is possible to predict changes in dose from the mean HU and noise level on MVCT images. To derive a clear threshold and a QA protocol, the measurements will be repeated using multiple HU-images and finally on patients.