AbstractID: 3032 Title: Evaluation of TomoTherapy"s MVCT number integrity

Purpose:
Megavoltage CT (MVCT) images of patients are acquired daily on a helical tomotherapy unit (TomoTherapy, Inc., Madison, WI). While these images are primarily used for patient alignment, they can also be used to recalculate the treatment plans in the daily anatomy. This, however, requires a reliable CT number to electron density calibration curve. We tested the integrity of the MVCT numbers by determining the variation of this calibration with time, spatial arrangement of the calibration phantom, and MVCT acquisition parameters.

Method and Materials:
To evaluate the stability of the calibration with time a CT to electron density phantom was scanned repeatedly over time intervals up to 9 months. To test the sensitivity to the spatial phantom arrangement the outer and inner ring test plugs were exchanged. The phantom was scanned with different pitch ratios to test for any sensitivity to this parameter. MVCT scans encompassed the length of the phantom plus a region where the test plugs are extended into air. These in-air slices were compared with the in-phantom slices. The two calibration curves that enveloped all observed variations were applied to six clinical MVCT images for recalculations to test for dosimetric uncertainties.

Results:
The largest variation of the calibration curve was observed between in-air and in-phantom scans. For the two extreme test plugs the scans the MVCT numbers differed by up to 82 MVCT numbers. Using these two calibration curves, the largest difference in any of the dosimetric endpoints among the clinical images was 3.1 % . More typically the dosimetric endpoints varied by less than 2 %.

Conclusion:
The stability of the electron density calibration curve is comparable to that of kVCT scanners and allows the establishment of a reliable MVCT to electron density calibration.

Conflict of Interest:
Three of the co-authors are employees of TomoTherapy, Inc.