

Purpose:

The purpose of this study was to evaluate the dosimetric uncertainties in TomoTherapy IMRT treatment planning due to the presence of high Z materials. Treatment plan calculations, and chamber measurements, were compared for accuracy with kilovoltage (KVCT), and megavoltage imaging (MVCT).

Method and Materials:

Electron density calibration curves were created using a Siemens Open Sensation unit for KVCT, and a TomoTherapy Hi-Art II unit for MVCT. Treatment plans were compared for a pelvic patient with bilateral hip replacements. In addition, for chamber measurements, treatment plans were also carried out on a phantom containing two high Z cerrobend inserts. The TomoTherapy Planned Adaptive module was used for IMRT calculation comparisons of KVCT and MVCT. Film profiles in the region of the heterogeneity were analyzed and compared using MatLab 7.0.

Results:

IMRT treatment planning calculations in the clinical image dataset resulted in a dose calculation discrepancy of 2.5% between KVCT and MVCT images. In addition, treatment planning with the phantom dataset, containing the high Z material, resulted in a 3.4% higher dose in the KVCT calculation compared to the MVCT calculation. Chamber measurements confirmed that the MVCT calculated treatment plan was within 0.05% of expected, while the KVCT calculated treatment plan was higher by 3.4% of actual measurement. Rendering from MatLab 7.0 showed that the KVCT film image was much noisier than MVCT film.

Conclusion

These results demonstrate that KVCT IMRT treatment planning may be prone to error in the presence of high Z prosthetics. Under these conditions, MVCT imaging may result in more accurate treatment planning calculations.