AbstractID: 5241 Title: Dose Calculation Accuracy in the Presence of High-Z Materials using Megavoltage CT for Treatment Planning

Purpose: Verify the accuracy of the dose calculation algorithm in the presence of a hip prosthesis when planning with megavoltage CT (MVCT) images of the TomoTherapy Hi-Art II planning system.

Methods and Materials:
Artifacts from imaging high-Z materials are greatly reduced in MVCT compared to kilovoltage CT (kVCT). This may allow more accurate treatment planning for patients with metallic implants. The Radiological Physics Center's (RPC) pelvic phantom was modified to accommodate a commercial Co-Cr-Mo hip prosthesis and imaged with both kVCT and MVCT. On the TomoTherapy Hi-Art II planning system, the MVCT-to-density table was extended to high-Z materials by including stainless steel and lead in the calibration. Contours were drawn on kVCT images without the prosthesis present and fused to the MVCT image set. Helical tomotherapy plans were created using the MVCT images with no constraints on beam entry or exit location. The delivered dose distribution was measured using TLDs in the PTV and EBT radiochromic film in the coronal and sagittal planes. Criteria based on TG-53 recommendations were used for comparison between measurements and calculations.

Results:
Dose calculation with MVCT images resulted in minor variations between calculated and measured dose. It was found that on average 97% of the dose distribution measured with film agreed with the treatment planning system to within +/-5% or 3mm. Profiles across the PTV also showed good agreement between measurement and calculation. The average TLD dose at the center of the PTV was 96.0% of the expected dose.

Conclusion:
Using dose calculations based on MVCT images, it is possible to accurately calculate the dose distribution in the pelvic region while treating through a high-Z prosthetic implant.