AbstractID: 5602 Title: The Hounsfield Unit (HU) accuracy in Varian's cone-beam CT (CBCT) and its effect on dosimetric verification

Purpose: To evaluate the HU accuracy of Varian's on board CBCT and its effect on the accuracy of dose calculation for dosimetric verification.

Methods and Materials: A mini CT QC phantom (15cm diameter, 2cm thickness) with different inserts (2cm diameter) of known electron densities was embedded into an IMRT QA phantom to form a body phantom and scanned using CBCT. The scan was acquired in half-fan and pulsed-fluoro mode with a half bowtie mounted. A technical setting of 125kV, 80mA and 25ms was used. The HU for each insert was measured and the HU-ED curve for CBCT was obtained. After that, a Rando pelvic phantom was scanned with both CBCT and SIM-CT using nearly the same KV. The two sets of CT were fused so that SSD at any beam direction agree to 1mm. In this way, the structures drawn in SIM-CT (to simulate prostate treatment) can be exactly transferred to CBCT. Without inhomgeneity correction; the two sets of CT generate exactly the same plan. With inhomogeneity correction, the dosimetric difference was mainly from the HU difference.

Results: The average HU difference between CBCT and SIM-CT is ~50 but the standard deviation of HU in CBCT is 3-4 times higher. Due to higher beam hardening effect in CBCT, the HU at phantom center is 60-80 higher than that at edges. There is also a ring artifact of 20cm diameter and 1.5cm broad in which the HU is 200 lower. Even though, the dosimetric difference with inhomogeneity correction is relatively small. The minimum dose, maximum dose and mean dose etc. for any structure generally agrees within ~2-5% between the CBCT plan and the SIM-CT plan. The CBCT plan is ~2% hotter at the phantom center.

Conclusions: Dosimetric difference between CBCT and SIM-CT is ~2-5% due to the inaccurate HU in CBCT.