AbstractID: 13705 Title: On the Potential of CBCT for Range Verification in Proton Therapy

Purpose: We have investigated the potential use of cone beam CT (CBCT) for beam range verifications in proton therapy treatment, in addition to its primary role in geometric targeting. Specifically, we studied the intrinsic imaging variability of a CBCT and its effect on the water equivalent path length (WEPL) calculations, in the context of daily beam range verification/correction required for a recently proposed method of treating prostate using anterior fields. The current approach uses only lateral fields due to the lack of precise range control in patient.

Materials and Methods: An anthropomorphic pelvic phantom was scanned using CBCT, in eight sessions on eight different days. In each session, the phantom was scanned twice, first at a standard position as determined by the room lasers, and then with a random shift of one centimeter in lateral directions. The Xio treatment planning system was used to perform the analysis. The average Hounsfield unit (HU) numbers for the water column in the rectal balloon was used to perform a linear calibration of the stopping power ratio, independently for each scan, as supported by the planning system. A number of WEPL values vertically from the anterior skin surface to the anterior surface of the water balloon were calculated on slices covering the region of the prostate, in relevance to a prostate treatment using an anterior field.

Results: The HU number in the water column varied significantly even within the same CBCT. The average value also varied from day to day for up to 20 units. However, when these average values are used to calibrate the stopping power ratio, the variations in WEPL values along the anterior beam path are mostly within 2 mm.

Conclusions: In-room CBCT can be used in proton therapy to make online verification of protons range in patients with 2mm accuracy.