AbstractID: 7583 Title: A Fiber-Optic Coupled Point Dosimetry System for the Characterization of Multi-Detector CT

Purpose: Advances in CT acquisition techniques, primarily multidetector CT (MDCT) and cone beam CT (CBCT), make it highly desirable to develop measurement techniques that provide a more physically meaningful measurement of dose than the traditional CT dose index (CTDI). This study presents data based on a point dosimetry system utilizing fiber-optic-coupled (FOC) radioluminescent dosimeters to measure fundamental parameters associated with CT dosimetry. This point detector approach provides remote, real-time dose measurements and allows direct recording of single-scan dose profiles that contain the essential information required to determine dosimetric quantities for MDCT.

Method and Materials: FOC dosimeters based on sensitive elements of either a copper-doped quartz or coupled scintillation phosphor are characterized for their performance across the CT energy range based on energy dependence, dose linearity, and angular response. A custom Labview program provides a user-friendly interface to control the system. Measurements were made using traditional CTDI as well as FOC dosimeter measurements for a variety of MDCT acquisition protocols.

Results: Measurements along the central axis of a CTDI phantom provide a direct evaluation of the single scan dose profile. FOC peripheral point measurements detect intensity variation with tube rotation, a dependence on scanner pitch, and permit the correlation of scan parameters and dose profiles. While CTDI remains an accurate prediction of MSAD for axial CT, it is empirically demonstrated to fail for multiple scan dose profiles when pitch is not equal to one. The development of a small dosimeter that can directly measure the helical dose profile provides a useful characterization of MDCT scanning performance and an accurate prediction of MSAD.

Conclusion: FOC dosimeters demonstrate high sensitivity, reproducibility, excellent dose linearity, and combined with their small physical size permit accurate point-dose measurements. These properties provide a useful tool for the characterization of the dosimetry quantities fundamental to MDCT.