AbstractID: 12914 Title: Quantification of starting angle dose biasing in helical computed tomography

Purpose: In helical computed tomography, the x-ray tube's starting angle determines the phase of sinusoidal-varying dose profile. By tailoring the periodic dose profile's troughs to radiosensitive anatomy, 60% dose reductions have been achieved in computational studies. This range of doses due to different starting positions is characterized by measuring starting angle dose bias (SADB). SADB is an issue for precision in both physical and computational organ dose measurements. A novel methodology is introduced which provides direct measurement of SADB for different organ positions, organ lengths and beam collimation.

Method and Materials: Expanding upon a mathematical derivation by Dixon et al, helical dose profiles were decomposed into axial and longitudinal dose profiles. Dose profiles were measured using a real-time dosimetry system optically-coupled to a water-equivalent, point, scintillator positioned within a cylindrical soft-tissue-equivalent phantom and scanned with a Siemens Somatom Sensation 16.

Results: SADB quantifies dose range from variable starting angle as minimum dose possible divided by maximum dose observed over an axial rotation. SADB ranged from 0.1755 for a 2 mm point detector located at the surface; to 1.000 for nearly any detector length located at isocenter. Increasingly isocentric positioning and longer detector length converged SADB to 1.000. Eye-lens dose performed on a tissue-equivalent phantom measurements agree within 2% to Monte Carlo-predicted dose biasing calculated by Zhang et al.

Conclusion: Dose reductions to specific organs can be achieved by manipulating the x-ray tube starting position in helical CT. Current scanners from GE, Philips, Toshiba, and Siemens use a random starting angle without the ability to predict starting position, which limits available dose reductions and creates uncertainties. SADB quantification represents previously unaddressed uncertainty for measurements of organ dosimetry, clinical exposure logs, and Monte Carlo simulations. This paper presents the first physical measurement of dose bias due to x-ray tube starting angle.