AbstractID: 7325 Title: X-ray scatter in a clinical CBCT system

Purpose: To investigate the magnitude of x-ray scatter, and to evaluate the effects of scatter related artifacts on a clinical cone-beam CT (CBCT) system.

Method and Materials: The scattered to primary energy fluence ratio (SPR) was measured as a function of cone angle using lead disks of 3 mm thickness placed on a stack of solid water phantom with thickness of 0, 5, 10, 18, 29 cm, representing air (couch only), extremity, chest, abdomen, and pelvis, respectively. The measurement was repeated with and without bowtie filter in the x-ray beam. The variation of scatter was evaluated by comparing the measurements with the lead disk placed at different positions in the x-ray field. The effectiveness of increase air-gap to reduce SPR was also tested using thickness of 18 and 29 cm of solid water phantom. The air-gap was increased from the minimum allowance of a clinical scan of about 30 cm to the maximum achievable approximately 42 cm for 18 cm phantom and 38 cm for 29 cm phantom.

Results: SPR of the CBCT system increases with thickness of the phantom, from 8% for couch only, to 64% for 29 cm depth of solid water phantom at the maximum cone angle with bowtie. For the depth of 29 cm, SPR varies from 26% at 2˚ cone angle to 64% at 12˚ with bowtie. The scatter fluence at different locations of the x-ray field remains constant without a bowtie filter, indicating the scatter kernel is space invariant. However, when using the half-fan geometry, the scatter increases with fan angles. As the air-gap increases, the SPR decreases almost linearly.

Conclusion: In CBCT imaging, scatter degrades image quality, especially for large body size, even with an anti-scatter grid. Scatter removal or correction is necessary for quantitative CBCT measurements.

Conflict of Interest: Supported by Varian.