AbstractID: 8147 Title: Measurement and Correction of Sagging Shifts in kV Cone-Beam CT from an On-Board Imaging System

Purpose: To evaluate the effects of sagging on mechanical isocenter accuracy and image quality of kV cone-beam CT (CBCT) and to develop a pre-processing algorithm for removing these effects from on-board-imaging (OBI).

Material and methods: OBI sagging shifts were measured by scanning a cubical phantom with a 2 mm metal marker. The metal marker was aligned with radiation isocenter and its position was tracked in cone-beam projections using normalized cross-correlation image registration algorithm of kV CBCT system. The position of the marker was determined by 650 projections of a CBCT scan over an angular range from 0^o-360^o. To remove sagging shifts, projections were corrected to reconstruct CBCT images using Feldkamp back projection. The marker center of the cubical phantom in the corrected CBCT reconstructed images was used to determine OBI isocenter. The CATPHAN from phantom lab was used to compare image quality parameters such as blurring, uniformity and linearity for CBCT images before and after OBI sagging shift corrections.

Results: We found that sagging affects localization accuracy of the OBI isocenter and image quality in CBCT. The marker position shifts about ± 2 mm over 360^o range due to sagging and this produces about 1.4 mm isocenter shift in CBCT reconstructed from projections before correction for sagging. CBCT numbers vary by about 1% in full-fan scans and up to 3.5% in half-fan scans. Blurring and spatial distortion artifacts are produced in CBCT before correction of OBI sagging shifts.

Conclusion: Sagging of the kV OBI system produces a systematic isocenter shift of CBCT. Further, sagging shifts lead to image artifacts such as spatial distortion, blurring, degradation of soft tissue contrast, position resolution, variation in CBCT number linearity and uniformity. Correction of OBI sagging in cone-beam projections prior to CBCT reconstruction provides more accurate isocenter localization and improves image quality.