# AbstractID: 12683 Title: Congruence of cone-beam CT image center with the radiation isocenter of a linear accelerator

**Purpose:** To develop a quantitative method to evaluate the cone-beam CT (CBCT) image center congruence with the linac radiation isocenter.
**Method and Materials:** A ball-bearing (BB) was placed in the proximity of the isocenter of a Varian Trilogy linac. The center of BB served as a static reference point in the space. The BB was imaged with square megavolt (MV) radiation beams at gantry angles of 0, 90, 180, and 270 degrees. The radiation isocenter was localized relative to the BB center based on the four MV EPID images. Then the BB was imaged with the CBCT. The CBCT image center was localized relative to the BB center. Finally, the 3D displacement between the CBCT image center and the radiation isocenter was computed.
**Results:** The CBCT image center was found to have excellent short-term positional reproducibility, i.e., <0.1 mm wobbling in each of the x(lateral), y(vertical), and z(longitudinal) directions in 10 consecutive acquisitions. Measured in a 7-month period, the CBCT image center deviated from the radiation isocenter by 0.40 ± 0.12 mm (x), 0.43 ± 0.04 mm (y), and 0.34 ± 0.14 mm (z). Small yet systematic discrepancies were found between the CBCT image center, 2D MV or kV portal image center, and the radiation isocenter. For the linac studied, we detected a 0.8 mm discrepancy between the CBCT image center and the MV EPID image center in the anterior-posterior direction. This discrepancy was demonstrated in a clinical case study where the patient was positioned with 3D CBCT imaging followed by 2D MV portal imaging verification.
**Conclusion:** The CBCT image center was localized relative to the radiation isocenter using a simple QA procedure. Computerized analysis revealed that the misalignment of CBCT image center was highly reproducible in short term and long term and could be quantified at sub-millimeter scale.