AbstractID: 11051 Title: A feasibility study for real-time tomosynthesis-guided Rapid Arc therapy

Purpose: To investigate the feasibility of real-time mis-alignment correction in Rapid Arc treatment and design a corresponding tomosynthesis acquisition protocol. **Method and Materials:** A CT image set of an anthropomorphic pelvic phantom was used in the study. Simulated projection images were produced to resemble a simultaneous kV fluoro in Rapid Arc treatment. A modified Feldkamp algorithm was used to reconstruct the tomosynthesis images. Various combinations of imaging reconstruction parameters including scan angle, angular interval, and slice thickness (mm) were tested: 1) $60°$, $6°$, 2.4; 2) $60°$, $6°$, 0.8; 3) $60°$, $3°$, 2.4; and 4) $30°$, $3°$, 2.4. A predefined 5 mm displacement in all three orthogonal directions modeled patient motion during treatment. After each successive tomosynthesis acquisition, registrations were performed between current reconstructions and reference images. The phantom position was corrected accordingly by shifting the treatment couch. Residual errors and their root mean square (RMS) values were recorded for evaluation. **Results:** The residual errors (L-R, A-P and S-I directions in mm) for the 4 schemes after the first tomosynthesis acquisition were (1.2, 2.5, -0.2), (-1.2, 1.1, 0.0), (1.1, 1.9, 0.0) and (-1.2, 3.1, 0.0), and the corresponding RMSs were 1.6, 0.9, 1.3 and 1.9 respectively. The RMSs after a full arc delivery were 0.7, 0.5, 0.5 and 0.7. All schemes tested accurately corrected displacement in the SI direction after first acquisition. Scheme 2 performed better than scheme 1 at the expense of more computation time. By doubling projection numbers in scheme 1, scheme 3 improved correction ability in the L-R direction. With a smaller $30°$ scan angle, scheme 4 was acceptable and will be improved after several acquisitions. **Conclusions:** Tomosynthesis scans can be used for real-time mis-alignment correction in Arc therapy after $30°$ gantry rotation.