AbstractID: 14158 Title: Investigate the equivalence of cone beam CT (CBCT) versus 4-dimensinoal (4D) MIP images for internal target volume (ITV) definition

Purpose: Maximum intensity projection (MIP) reconstructed 4-dimensional (4D) computed tomography (CT) reflects the range of target motion and thus is generally used for internal target volume (ITV) definition in lung stereotactic body radiotherapy treatment planning. During treatment delivery, CBCT is used for image guidance by aligning the visualized target in the CBCT with the MIP-based ITV. This work investigates whether these two image modalities are equivalent in defining an ITV.

Materials and Methods: A ball-shaped polystyrene phantom with different built-in objects (cube, cone, and sphere) was attached to a motor-driven platform, which simulates a sinusoidal movement with changeable motion amplitude and frequency. The motion of the platform was set along patient superior-inferior direction with 1-cm peak-to-peak amplitude. The Varian on-board Exact Arms kV CBCT system and the GE LightSpeed 4-slice CT integrated with Respiratory Position Management 4DCT scanner were used to scan the phantom that moved with three frequencies (e.g. 3.4, 4.5, and 5.8 seconds). MIP images were produced. The objects were contoured in the MIP and CBCT images, respectively, and the volumes of these objects were compared between the two sets of images.

Results: It was found that the MIP-based volumes of these objects increase with the increase of the motion period while the CBCT-based volumes do not change with the frequency. Even for the fast motion (3.4 sec), the volumes contoured in the MIP images, which are smallest among the volumes of three frequencies, are generally 10% larger than those delineated from CBCT.

Conclusions: The delineated volume of an ITV changes as the frequency of target motion changes in the MIP reconstructed 4DCT. The delineated volume of a moving target is not affect by the frequency, but by motion magnitude, in CBCT. In general, CBCT and MIP images are not equivalent in defining an ITV.