Purpose: To assess the impact of respiratory velocity on target volume using four-dimensional computed tomography (4DCT).

Methods and Materials: A 20 mm diameter object in a QUASAR^{TM} phantom sinusoidally moved with 10 mm amplitude along the longitudinal axis of the CT couch. The motion period was set in the range of 2-12s ec at 2 sec intervals. 4DCT data were acquired on a General Electric 4-slice Lightspeed RT CT scanner in an axial cine mode. Respiratory motion was recorded by a Varian Real-time Positioning Management system. A CT slice thickness and image acquisition time were 1.25 mm and 0.5 sec, respectively. The cine duration was set to the motion period plus 2 sec. The number of 10 images per each couch position was reconstructed. Measurement repeated 3 times for each pattern. The object was automatically segmented using threshold on CT images. Volumetric analysis was performed to evaluate variations in the object size by different periods.

Results: The maximum volume of the object was 6.35 ml at a maximum instantaneous velocity (V_{max}) of 30.11 mm/sec, which was larger by 51.2% than true volume. While the probability that a difference between imaged volume and true volume was more than 5% was 37.3% at the velocity of ≤ 10.68 mm/sec corresponding to the V_{max} with the period of 5.87 sec, it increased to 96.3% at the velocity of >10.68 mm/sec. A significant difference was seen between the mean volume with the period of ≤ 10.68 mm/sec and >10.68 mm/sec (P<0.01).

Conclusions: Severe motion artifacts are more pronounced at higher respiratory velocity. Even if the respiratory period is slow, motion artifacts remain as long as the object moves during CT data acquisition.