Purpose: To compare demons deformable registration with rigid and affine registration methods by measuring registration accuracy and image texture changes introduced by each algorithm.

Methods: Eleven temporally sequential pairs of clinical thoracic CT scans demonstrating no abnormal pathology were collected retrospectively from different patients. Rigid, affine, and demons registration methods were applied to all scan pairs using an appropriate choice of registration parameters. 150 landmarks were automatically selected in each baseline scan, and a semi-automated approach was used to identify corresponding landmarks in the respective deformed follow-up scans. Eleven first-order texture features were calculated in 32x32-pixel regions of interest (ROIs) randomly placed in the baseline scans and at anatomically matched locations in the demons-, rigid-, and affine-registered follow-up scans. For each ROI pair, feature value differences between the three registered follow-up scans and the baseline scan were calculated.

Results: The average per-patient Euclidean distance between baseline scan landmarks and registered follow-up scan landmarks ranged from 0.01-0.50 mm (overall mean: 0.18 mm), 1.6-6.8 mm (overall mean: 3.95 mm), and 2.06-7.91 mm (overall mean: 4.82 mm) for demons, affine, and rigid registration methods, respectively. Across all eleven features, the variances in feature value change for rigid and affine registration methods were at least an order of magnitude larger than the corresponding feature-value-change variances for demons registration.

Conclusions: Demons registration achieved more accurate spatial alignment between temporally sequential CT scans than rigid or affine registration methods. Furthermore, the variance in texture feature value changes between baseline and registered follow-up scan ROIs was smaller for demons than for rigid or affine registration methods. These advantages of demons registration observed with 'normal' thoracic CT scans indicate that future studies may incorporate demons to combine serial CT scans such that automated methods may distinguish registration artifacts from actual pathologic change.