Conclusion: The amount of change in dose parameters due to respiratory motion was smaller with the FIF technique than with irradiation using PWs, within an acceptable range.

Material and Methods: Ten patients with early stage breast cancer were enrolled. All patients had undergone breast-conserving surgery and implantation of 4 surgical clips on the tumor bed, 2 of which had been placed in the nipple side of the tumor bed and 2 on each medial and lateral side of the tumor bed. Computed tomography (CT) was performed during free breathing (FB). After the FB-CT data set acquisition, 2 additional CT scans were obtained during a held breath after light inhalation (IN) and light exhalation (EX). Based on the FB-CT images, 2 different treatment plans (FIF-plan and PW-plan) were created for the entire breast for each patient and copied to the IN-CT and EX-CT images. The prescribed dose was 50 Gy in 25 fractions. The amount of change of the volume of the target receiving 107%, 95%, and 90%, respectively, on the IN-plan and EX-plan compared with the FB-plan were evaluated. The length of movement of each surgical clip from EX-CT to IN-CT in 3 directions (horizontal, anteroposterior, and craniocaudal) and three-dimensional vector displacement were measured.

Results: The average displacement length was largest in the anteroposterior direction and the average three-dimensional vector displacement was 7.4mm. The V107%, V95%, and V90% were significantly larger for the IN-plan than for the FB-plan in both the FIF and PW plans. While the amount of change in the V107% was significantly smaller in the FIF than in the PW plan, the amount of change in the V95% and V90% was significantly larger in the FIF plan. Thus, the increase in the V107% was smaller while the increases in the V95% and V90% were larger in the FIF than in the PW plan.

Conclusion: The amount of change in dose parameters due to respiratory motion was smaller with the FIF technique than with irradiation using PWs, within an acceptable range.

EP-1736
The quantitative measurement of liver motion in CT during respiration
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Purpose or Objective: To evaluate the motion of different liver segments in CT during respiration to facilitate target delineation and ITV expansion for liver cases.

Material and Methods: Eleven patients with whole liver scanning during free breath in both regular helical CT and 10-phase-gated 4D CT were investigated. It included 1 esophagus, 3 lung, 5 breast, 1 liver, and 1 thymoma patients. Nine representative points in 1 cm diameter (in liver segment 1, 2, 3, 4a, 4b, 5, 6, 7, 8, respectively) were drew in the image of helical CT and adaptive deformed to 4D CT, using SmartAdapt, a tool in Eclipse version 11.5. The coordinate of centroid represented the location of point. Distances of centroid represented the location of point. Distances of specific liver segments, the motion along X-, Y-, Z-axis were measured. The liver deformation, which was the overlapping liver area of deformed helical CT and 4D CT divided by whole liver area in 4D CT.

Results: Mean moving distances along X-, Y-, Z-axis from phase 0 CT to phase 50 CT were -0.10±0.32 (mean±SD)(cm), 0.24±0.24, and 0.60±0.36, respectively, averaging from the 9 points of 11 investigated patients. The result indicated liver motion to the right, back, and upside while expiration. For specific liver segments, the motion along X-, Y-, Z-axis were S1: -0.23±0.31, 0.15±0.16, 0.55±0.29, S2: -0.06±0.32, 0.15±0.29, 0.57±0.43, S3: -0.04±0.23, 0.32±0.19, 0.61±0.26, S4a: -0.19±0.27, 0.08±0.23, 0.23±0.28, S4b: -0.14±0.13, 0.27±0.20, 0.66±0.28, S5: -0.01±0.27, 0.35±0.25, 0.57±0.23, S6: -0.05±0.41, 0.25±0.25, 0.75±0.32, S7: -0.20±0.40, 0.26±0.21, 0.95±0.33, S8: 0.01±0.42, 0.32±0.29, 0.55±0.38. All segments moved to the right except segment 8 with mean moving distance 0.01cm to the left. Otherwise, all segments moved to the back and upside while expiration. Segment 7 was the most mobile one on the Z-axis with 0.95±0.33cm upwards. The accuracy ratio of whole liver deformation were 0.96±0.03 for phase 0 CT and 0.97±0.02 for phase 50 CT, respectively, denoting the adaptive deformation is quite accurate.

Conclusion: The liver motion in CT during respiration is different between different liver segments. The most mobile one is segment 7 on the Z-axis. The quantitative motion measurement could be a useful reference for ITV expansion to ensure preciseness in target delineation for liver cases.

EP-1737
Intrafraction motion and ITV dose coverage in thoracic SBRT: preliminary analysis of 101 CBCT images
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Purpose or Objective: To evaluate the impact of intrafraction organ motion on the dosimetric coverage of ITV by the analysis of a preliminary data set of 101 CBCT images acquired in 7 patients treated according to an SBRT protocol for primary and metastatic thoracic tumors.

Results: Mean moving distances along X-, Y-, Z-axis from phase 0 CT to phase 50 CT were -0.10±0.32 (mean±SD)(cm), 0.24±0.24, and 0.60±0.36, respectively, averaging from the 9 points of 11 investigated patients. The result indicated liver motion to the right, back, and upside while expiration. For specific liver segments, the motion along X-, Y-, Z-axis were S1: -0.23±0.31, 0.15±0.16, 0.55±0.29, S2: -0.06±0.32, 0.15±0.29, 0.57±0.43, S3: -0.04±0.23, 0.32±0.19, 0.61±0.26, S4a: -0.19±0.27, 0.08±0.23, 0.23±0.28, S4b: -0.14±0.13, 0.27±0.20, 0.66±0.28, S5: -0.01±0.27, 0.35±0.25, 0.57±0.23, S6: -0.05±0.41, 0.25±0.25, 0.75±0.32, S7: -0.20±0.40, 0.26±0.21, 0.95±0.33, S8: 0.01±0.42, 0.32±0.29, 0.55±0.38. All segments moved to the right except segment 8 with mean moving distance 0.01cm to the left. Otherwise, all segments moved to the back and upside while expiration. Segment 7 was the most mobile one on the Z-axis with 0.95±0.33cm upwards. The accuracy ratio of whole liver deformation were 0.96±0.03 for phase 0 CT and 0.97±0.02 for phase 50 CT, respectively, denoting the adaptive deformation is quite accurate.

Conclusion: The liver motion in CT during respiration is different between different liver segments. The most mobile one is segment 7 on the Z-axis. The quantitative motion measurement could be a useful reference for ITV expansion to ensure preciseness in target delineation for liver cases.

EP-1737
Intrafraction motion and ITV dose coverage in thoracic SBRT: preliminary analysis of 101 CBCT images
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Purpose or Objective: To evaluate the impact of intrafraction organ motion on the dosimetric coverage of ITV by the analysis of a preliminary data set of 101 CBCT images acquired in 7 patients treated according to an SBRT protocol for primary and metastatic thoracic tumors.
Material and Methods: Between 2013 and 2015 seven pts, 5 males and 2 females, median age 77 yrs (range: 35-85 yrs) received SBRT for primary or metastatic thoracic tumors: 4 primary lung cancer, 2 mediastinal lymphnode metastasis, 1 lung metastasis. All pts had a 4D-CT high-resolution simulation in 10 respiratory phases for ITV definition. GTV and ITV volumes were 4.5-21.4 cm3 and 6.8-39.4 cm3, respectively. ITV-PTV margins were 5 mm (median), range: 3-5 mm. All pts were treated by IG-IMRT volumetric modulated arc therapy with 2 modulated arcs. Doses were prescribed according to ICRU 83 (median PTV dose) and 99% of PTV had to be encompassed by 90% isodose. Total doses were: 20 Gy x 3 in 1 pt, 12 Gy x 4 in 1 pt, 10 Gy x 5 in 1 pt, 7.5 Gy x 8 in 1 pt, 6 Gy x 8 in 3 pts. Before CBCT acquisition in all pts 2 planar (AP-LL) set-up EPID images (kV/MV) were taken for preliminary set-up analysis. In absence of rotations on EPID imaging, CBCT images (Nr.=44) were acquired for on-line setup corrections which were applied before of each 1st SBRT treatment arc. Intra-fraction motion was evaluated by further CBCT images acquired before starting and at the end of the 2nd treatment arc. Structure matching on CBCT was automatically done first on bone and then on soft tissue. In-room mean elapsed time between 1st and last CBCT was 26 min (range:11-47 min). On-line set-up corrections between 1st and 2nd arc were applied for errors of ±3 mm. For the whole series of 7 pts mean differences between planned and delivered ITV median dose, V90, V95, and D98 were calculated.

Results: Mean ITV displacements after the 1st arc were 1.2 mm ± 1.6 mm, 0.5 mm ± 1.4 mm, 0 mm ± 1.1 mm for CC, AP and LL directions, respectively. Mean displacements at the end of 2nd arc were 0.1 mm ± 1.4 mm, 0.7 mm ± 1.0 mm, 0.3 mm ± 0.9 mm for CC, AP and LL directions, respectively. Differences between planned and delivered ITV median dose ranged from -0.2% to -1.8%; V90 was ≥ 99.8% in all pts, V95 was ≥ 99.8% in all pts (Fig. 1).

Conclusion: Our preliminary analysis of 101 CBCT in 7 pts aimed at evaluating intra-fraction organ motion during V-MAT SBRT of thoracic targets shows that ITV dosimetric coverage is only minimally influenced by intra-fraction ITV displacement, provided that on-line corrections are applied before each treatment arc. Our findings need to be prospectively confirmed in a larger patient series.

EP-1739
Deep inspiration breath hold with ‘AlignRT’ in 3D conformal mediastinal radiotherapy for lymphoma
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Purpose or Objective: To report our experience of using ‘AlignRT’ (Elekta Ltd, Stockholm, Sweden) to perform deep inspiration breath hold (DIBH) treatment for mediastinal lymphoma.

Material and Methods: 30 patients with mediastinal lymphoma underwent CT simulation with DIBH. Data collected included demographics, treatment volume, planning target volume (PTV), dosimetric parameters, and PTV coverage. PTV coverage was compared between the DIBH plan and the free breathing (FB) plan.

Results: The PTV coverage in plans with DIBH was significantly better than in FB plans (p<0.001). The FB plans resulted in a significant increase in dose to the heart, lung, and contralateral breast.

Conclusion: DIBH with ‘AlignRT’ significantly improves PTV coverage in mediastinal lymphoma patients compared to free breathing. This technique may be useful in improving target coverage and reducing normal tissue toxicity in this patient population.