radiotherapy are planned, including specialized tools for quick visual evaluation and manual corrections.

PO-1093
Comparison of IV contrast enhancement between 4DCT and helical radiotherapy planning scans for lung cancer
T. Paté1, J. Keeble1, L. Allington1, H. Grimes1, N. Hindocha1, J. Godbold2, R. Mendes1
1UCLH, Radiotherapy, London, United Kingdom

Purpose/Objective: 4DCT allows visualisation of tumour and organs at risk motion over the whole breathing cycle. This enables the creation of an internal target volume and individualised planning margins. At UCLH previous practice for node positive lung cancer was to perform a helical scan plus IV contrast, to delineate the nodal areas. A region of interest 4DCT was then acquired for tumour motion. It was deemed not possible to maintain contrast enhancement through the entire total lung 4DCT. However, after discussions with the UCLH imaging department, from November 2013, a new practice to administer contrast whilst obtaining a total lung 4DCT scan was instigated. A retrospective audit was conducted to compare enhancement of the contrast in both practices and its acceptability for radiotherapy planning.

Materials and Methods: The radiotherapy scans for 40 lung cancer patients were used to evaluate the enhancement of contrast throughout vascular structures. Retrospective evaluation of helical CT plus contrast followed by a regional 4DCT plus contrast in 20 patients was performed. All patients received 100ml Omnipaque 350 mgI/mL intravenously in the arm. During the helical scan, a flow rate of 2-3ml/s and a time delay of 45 seconds were used. During the total lung 4DCT scans, a flow rate of 1ml/s and a time delay of 45 seconds were used. For each scan, on the axial slices an area profile of 9 x 9mm was created to determine the mean Hounsfield unit (HU) and standard deviation (SD) of the following structures: ascending aorta, right atrium, left ventricle, right ventricle and descending aorta at the inferior aspect of both the heart and lungs. This method is consistent with Cademartiri et al (2006).

Results: The sample consisted of 29 males and 11 females with diagnoses of 11 NSCLC, 6 SCLC, 13 SCC, 8 adenocarcinomas and 2 presumed lung cancers. The mean HU and SD for vascular structures within the helical and total lung 4DCT scans:

<table>
<thead>
<tr>
<th>Structure</th>
<th>Helical Scan HU</th>
<th>Helical Scan SD</th>
<th>Total lung 4DCT HU</th>
<th>Total lung 4DCT SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascending aorta</td>
<td>394</td>
<td>11</td>
<td>393</td>
<td>8</td>
</tr>
<tr>
<td>Right atrium</td>
<td>314</td>
<td>23</td>
<td>167</td>
<td>12</td>
</tr>
<tr>
<td>Left ventricle</td>
<td>307</td>
<td>21</td>
<td>148</td>
<td>11</td>
</tr>
<tr>
<td>Right ventricle</td>
<td>175</td>
<td>14</td>
<td>135</td>
<td>11</td>
</tr>
<tr>
<td>Ascending aorta-heart</td>
<td>234</td>
<td>12</td>
<td>147</td>
<td>11</td>
</tr>
<tr>
<td>Descending aorta-lung</td>
<td>296</td>
<td>15</td>
<td>138</td>
<td>12</td>
</tr>
</tbody>
</table>

The population mean HU and SD for the total lung 4DCT were lower compared to the helical scan (155HU ± 11) vs (233HU ± 16). However, all total lung 4DCT plus contrast scans were clinically acceptable for radiotherapy purposes and none have been rejected due to limited contrast enhancement since the change of practice.

Conclusions: The level of contrast enhancement within the total lung 4DCT scans is clinically acceptable for the purpose of delineation of thoracic target volumes and organs. A total lung 4DCT with contrast results in a lower CT dose to the patient than a helical scan with contrast followed by a regional 4DCT. This streamlined process reduces the scan time for the patient in the radiotherapy position which increases patient compliance. This new practice results in a single dataset which reduces the inherent error of co-registering multiple datasets and reduces the risk of delineation on the incorrect dataset.

Poster: RTT track: Treatment planning and dose calculation

PO-1094
Tracking, gating, free-breathing, what is the best dose distribution for lung stereotactic treatments?
J. Molinier1, P. Boisselier2, N. Aillères1, S. Siméon1, L. Bedos3, D. Azria1, P. Fenoglietto1
1ICM Val d’aurelle, Radiation Oncology, Montpellier, France

Purpose/Objective: Tracking, gating and free-breathing (FB) systems are three stereotactic body radiation therapy techniques (SBRT) which can be used for lung treatments. The purpose of this study is to look deeper in the advantages from one technique to the other by a dosimetric parameters comparison.

Materials and Methods: Ten patients, previously treated using linac-based SBRT, were selected for this analysis. 4DCT data were acquired for each patient and sorted into 10 phases of breathing cycle such as 0% and 50% phases defined respectively inhalation and exhalation maximum. GTVph, PTVph (=GTVph+3mm) and healthy irradiated lung were contoured on each phase. The prescribed dose was 60Gy in 4 fractions. For tracking technique, 3D conformal SBRT with 9 fields were planned for every phase and were summed. Tracking plans were normalized such as 99% dose covered 99% of PTVph and respected dose constraints of ROSEL study. Gating technique was analyzed with 3 exhalation phases (40-50 and 60% phases). For free-breathing technique, ITVFB was defined from all GTVph and 3mm margin on ITVph defined a PTVFB. PTVfb was reported on each respiratory phase images and dose distributions were calculated. The dose normalization and dose constraints were the same as for tracking technique. Finally, 10 plans were summed. This method allowed knowing the dose really received by the GTV (from all GTVph) during a free-breathing irradiation.

The 3 modalities were evaluated using dose-volume histograms of each GTVph and PTVph, homogeneity index (HI=(Dmax-Dmin)/Dmean) and the doses to healthy irradiated lung (Dmean and V20Gy).

Results: Despite similar maximum doses, free-breathing system improved the target coverage by increasing Dmax and Dmean. Target coverage was slightly more homogeneous with this technique too. On the other hand, the healthy irradiated lung is better protected with tracking system even if dose constraints were respected in the 3 cases (V20Gy<10%).
Conclusions: Tracking, gating and free-breathing techniques provide plans with good target coverage and healthy lung protection. While an irradiation with free-breathing increases doses to GTV and PTV, an irradiation with tracking system spares better the healthy lung but can dramatically increase the treatment complexity.

PO-1095
Comparison of TPS and actual measurement on the surface under the electron beam therapy with bolus
B. Kim1, J. Park1, B. Park1, Y. Song1, B. Park1, K. Song1
1Samsung Medical Center, Radiation Oncology, Seoul, Korea Republic of

Purpose/Objective: If electron, chosen for superficial oncotherapy, was applied with bolus, it could work as an important factor to a therapy result by showing a drastic change in surface dose. Hence the calculation value and the actual measurement value of surface dose of Treatment Planning System (TPS) according to four variables influencing surface dose when using bolus on an electron therapy were compared and analyzed in this paper.

Materials and Methods: Four variables which frequently occur during the actual therapies (A: bolus thickness - 3, 5, 10 mm, B: field size - 6x6, 10x10, 15x15 cm2, C: energy - 6, 9, 12 MeV, D: gantry angle - 0°, 15°) were set to compare the actual measurement value with TPS (Pinnacle 9.2, philips, USA). A computed tomography (lightspeed ultra 16, General Electric, USA) was performed using 16 cm-thick solid water phantom without bolus and total 54 beams where A, B, C, and D were combined after creating 3, 5 and 10 mm bolus on TPS were planned for a therapy. At this moment SSD 100 cm, 300 MU was investigated and measured twice repeatedly by placing it on iso-center by using EBT3 film (International Specialty Products, NJ, USA) to compare and analyze the actual measurement value and TPS. Measured film was analyzed with each average value and standard deviation value using digital flat bed scanner (Expression 10000XL, EPSON, USA) and dose density analyzing system (Complete Version 6.1, RIT, USA).

Results: For the values according to the thickness of bolus, the actual measured values for 3, 5 and 10 mm were 101.41%, 99.58% and 101.28% higher respectively than the calculation values of TPS and the standard deviations were 0.0219, 0.0115 and 0.0190 respectively. The actual values according to the field size were 6x6, 10x10 and 15x15 cm2 which were 99.63%, 101.40% and 101.24% higher respectively than the calculation values and the standard deviations were 0.0138, 0.0176 and 0.0220. The values according to energy were 6, 9, and 12 MeV which were 99.72%, 100.60% and 101.96% higher respectively and the standard deviations were 0.0200, 0.0160 and 0.0164. The actual measurement value according to beam angle were measured 100.45% and 101.07% higher at 0° and 15° respectively and standard deviations were 0.0199 and 0.0190 so they were measured 0.62% higher at 15° than 0°.

Conclusions: As a result of analyzing the calculation value of TPS and measurement value according to the used variables in this paper, the values calculated with TPS on 5 mm bolus, 6x6 cm2 field size and low-energy electron at 0° gantry angle were closer to the measured values, however, it showed a modest difference within the error bound of maximum 2%. If it was beyond the bounds of variables selected in this paper using electron and bolus simultaneously, the actual measurement value could differ from TPS according to each variable, therefore QA for the accurate surface dose would have to be performed.

PO-1096
Inter-fraction variation of gas volume in the abdominal region during radiotherapy for distal esophageal cancer
M. Kamphuis1, N. Van Wieringen1, P. Jin1, T. Alderliesten1, R. Van Os1, A. Bel1, M.C.C.M. Hulshof1
1Academic Medical Center, Radiotherapy, Amsterdam, The Netherlands

Purpose/Objective: The volume of gas in the upper abdominal region in patients treated for distal esophageal cancer can change during the course of radiotherapy and this can influence daily dosimetry. Recently we have observed individual cases in which systematic local dose differences up to 10% occurred for which replanning was needed. More knowledge on the behaviour of abdominal gas is essential for creating a protocol on how to deal with systematic and random changes in the amount of gas. The aim of this study was to quantify changes in the amount of gas in the area of the planning target volume (PTV) over the course of radiotherapy.

Materials and Methods: This study was performed on two populations. Group A consisted of 19 randomly selected distal esophageal cancer patients and group B consisted of 7 distal esophageal cancer patients already showing a large initial amount of gas on the planning CT-scan. Patients received preoperative or definitive chemoradiotherapy. Radiotherapy consisted of 41.4Gy and 50.4Gy, respectively, in 1.8Gy dose per fraction. Chemotherapy was administered weekly and consisted of carboplatin and paclitaxel. The amount of gas in the upper abdomen was determined on weekly cone beam CT (CBCT) scans at the level of the PTV. Voxels with CBCT units below -525 were considered to be gas, and units above -525 were considered abdominal tissue. Lung was not considered as gas volume, therefore all slices were visually checked and manually edited if necessary. This procedure was performed for every patient on 4 CBCT-scans from each week of treatment. The initial CT-scan was not used in this study, to get a consistent comparison, independent of possible grey value differences between CT and CBCT. Averages and standard deviations (SD) were calculated for both populations for each week of the treatment. Statistical tests were performed to test for significance in the differences in the amount of gas between the different weeks of treatment.

Results: Figure 1 shows the results of the weekly gas volume measurements of individual patients from group A. Averages of both groups are presented in table 1. No significant differences were found between the subsequent weeks of treatment in either of the investigated populations, although