Results: Datasets from 10 patients were obtained for a total of 705 CBCT scans - the first 3 patients were excluded from the study due to changes in methodology partly through treatment. The mean 3D vector of residual setup error post first correction (4DOF) was 0.7 ± 0.4 mm (mean ± SD) and the maximum 3D vector was 2.2mm. The mean 3D vector of residual setup error post second correction (4DOF) was 0.2 ± 0.1mm and the maximum 3D vector was 0.8mm. The mean 3D vector of intra-fraction motion was 0.4 ± 0.2mm and the maximum 3D vector was 1.3mm.

Conclusion: Incorporating a second correction pre-treatment significantly reduced the residual inter-fraction setup error from 0.7 ± 0.4 mm to 0.2 ± 0.1mm. The intra-fraction motion for this cohort of patients was twice as large as the residual inter-fraction setup error. Efforts are currently underway to reduce this intra-fraction motion by focusing on improvements to the immobilization system.

PO-0903

IGRT for a highly conformal VMAT-technique for simultaneous treatment of the breast and lymph nodes

B. Houben-Haring1, M. Admiraal1
1VU University Medical Center, Department of Radiotherapy, Amsterdam, The Netherlands

Purpose or Objective: Recently we introduced an improved hybrid treatment planning technique for breast with simultaneous irradiation of axillary and supraclavicular lymph nodes (level I-IV). This technique combines tangential open fields with VMAT (RapidArc®, Varian Medical Systems) and results in a highly conformal coverage of the lymph node region, with a steep dose fall-off towards esophagus and thyroid. The purpose of this study is to evaluate the validity of this conformal planning technique, with the required setup and image guidance.

Material and Methods: Ten patients were included, of which 8 were treated in Free Breathing and 2 were treated in Deep Inspiration Breathhold. Fractionation was 16 x 267 cGy for both elective breast and lymph node regions. PTV-margin of level I-IV lymph nodes is 5 mm to the medial direction and 8mm for all other directions (image 1). Daily online setup was performed on bony anatomy with 2 orthogonal kV-images and subsequent verified with medio-lateral MV field imaging. At the level of the PTV nodes setup deviation up to 3mm was allowed in lateral direction, in all other directions and for the humeral head 5mm was allowed. At the first 3 fractions and weekly a CBCT was acquired for verification of the PTV coverage of the lymph nodes. All CBCT’s were used offline for analysis of the reproducibility of level I-II nodes, level III-IV nodes, humeral head and bony anatomy. All 160 fractions were used for evaluation of the efficiency of the setup and imaging procedure.

Results: A t-test showed a significant relation between the position of the humeral head and all the nodes in crano-caudal direction (p<0.001) and for level III-IV also in lateral direction (p<0.01). Repositioning was required in 31 fractions (19%). This was reduced to 19 fractions (12%) by excluding 1 patient with positioning problems. Based on the CBCT’s, we found that only in 2% of all cases, an off-set of the humeral head less than 8mm lead to a deviation of the nodal PTV of more than 5mm. Analysis of the CBCT’s also showed that the remaining average setup error for level I-II nodes and level III-IV was less than 2mm in all directions with SD of max 1.6mm in AP direction (Table 1).

Table 1: Residual setup error of the lymph nodes and humeral head after daily cone-beam computed tomography registrations.

<table>
<thead>
<tr>
<th>Node</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level I-III lymph nodes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Original</td>
<td>0.02</td>
<td>0.01</td>
<td>0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>Second correction</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.10</td>
</tr>
<tr>
<td>Level IV lymph nodes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Original</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Second correction</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Humeral head</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Original</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Second correction</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Conclusion: The positioning of the lymph nodes level I-IV can be well addressed by the position of the surrounding bony anatomy and the humeral head. For the adequate treatment of both the lymph node regions and the breast, two orthogonal kV-images and MV field imaging are sufficient.

PO-0904

Bladder changes assessment using daily cone-beam computed tomography

1Aarhus University Hospital, Department of Medical Physics, Aarhus, Denmark
2University of California San Diego, Department of Radiation Medicine and Applied Sciences, San Diego, USA
3Memorial Sloan Kettering Cancer Center, Department of Medical Physics, New York, USA

Purpose or Objective: Late genitourinary (GU) and gastrointestinal (GI) toxicities are the main dose limiting factors prostate radiotherapy plans. However, no predictive models, and consequently, no consensus guidelines have been reported for GU toxicity. One possible explanation is that the plan dose-volume histogram (DVH) is not representative of uncertainties. Modern image guidance techniques, in particular the use of cone beam computed tomography (CBCT), facilitate reconstruction of the accumulated dose. The aim of the study was to compare planned with accumulated dose and volume data for the bladder with the latter assessed from daily CBCT imaging and deformable image registration (DIR).

Material and Methods: Eight subjects presenting with RTOG GU Grade 2+ toxicity were selected from a cohort of 287 patients treated for prostate cancer in 2006-2013. Prescribed dose was 81Gy in 45 fractions. The 8 subjects were each matched to 3 patients without GU toxicity by the following criteria: pretreatment GU symptoms (IPSS score), age ± 5y, risk group (low, intermediate, high), whole pelvis vs. prostate, and use of neoadjuvant ADT. Treatment required adherence to a full bladder and empty rectum protocol. Daily CBCT was used for patient realignment and to assess bladder and rectal filling status. Dose from planning CT was rigidly registered to CBCT using recorded daily shifts followed by bladder contour propagation from plan CT to the first day CBCT and then to the remaining CBCTs using an intensity-based deformable image registration (DIR) algorithm. Bladder contours were corrected manually and the accumulated D10 and D20 (defined as the highest dose received by a volume up to 10 and 20 cm3 of the bladder, respectively) were compared to corresponding values from the planned DVH. All registrations and DVHs computations were done using MIM Maestro 6.4.4 (MIM Software Inc. Cleveland, OH, US).

Results: In the analyzed patients, the bladder volumes in the daily CBCTs were found to vary between 62% and 256% of that from the planning CT, with a mean difference in volume ranging from 63% to 20%. Differences in the compared DVH were also observed where D10 was ±2.7%, and D20 ±11.2% of the corresponding planned metrics.
Material and Methods: Three patients with repeated CT scans of the thoracic spine were included. A CT of one thoracic vertebra was delineated, a PTV was created with an isotropic margin of 5 mm around the CTV. A clinical thoracic vertebra was delineated, a PTV was created with an isotropic margin of 5 mm around the CTV. A clinical reference plan with a prescription dose of 800cGy (single fraction) was created in a research version of Monaco (Elekta) (figure 1). The second CT scan was used to mimic daily imaging at the MRL. The second CT was shifted in left-right and anterior-posterior direction. Instead a Virtual Couch Shift (VCS) is applied: the possibility for on-line adaptation on the current anatomy. In total, 52% of the VCS plans were acceptable. Left-right shifts resulted mainly in an unacceptable V107. With SWO, 63% of the plans were accepted, the unaccepted plans had a V107>2cm³. With SWO+SSO, 98% of the plans were accepted. The last 2% failed due to minimal hotspots in the PTV. The average calculation time to create a reference plan was 205 sec. The mean calculation time of a VCS plan, SWO plan and SWO+SSO plan was 125 sec, 9 sec and 507 sec, respectively.

Conclusion: VCS seems to works well for half of the cases, further optimization results in acceptable plans. The time to create VCS plans and SWO plans is compatible with an online setting. SWO+SSO results in stable plans. However, this takes long time in comparison with creating a new plan. To determine for what extent of shifts, acceptable plans can be created, more plans will be made. Then a trade of can be made when to create a VCS/SWO(SWO) plan or start a new plan.

PO-0906
NTCP differences between planned and delivered dose in treatment for head and neck cancer
J. Heukelom1, C. Fuller2, M. Kantor2, K. Kauwe1, C. Rasch3, J.J. Sonke1
1The Netherlands Cancer Institute, Department of Radiation Oncology, Amsterdam, The Netherlands
2MD Anderson Cancer Center, Radiation Oncology, Houston, USA
3Academic Medical Center, Department of Radiation Oncology, Amsterdam, The Netherlands

Purpose or Objective: During the 7 weeks of radiation therapy, the anatomy of head and neck cancer patients changes, resulting in a difference between planned and delivered dose. Currently, the allocation of adaptive radiotherapy (ART) is often based on visual inspection of repeated imaging or dosimetric criteria and thus only implicitly on changes in treatment outcome. Normal Tissue Complication Probability (NTCP) is a metric that translates the treatment dose distribution to treatment outcome. The goal of this study was to assess the impact of anatomical changes over the course of radiation therapy and the consequential difference in NTCP.

Material and Methods: For 36 squamous cell head and neck cancer patients treated in a single tertiary cancer center, daily in room CT scans were made in treatment position using CT on rails. In post-treatment analysis, the original beam set up was used to calculate dose of the day. Additionally, the daily CT was deformably registered to the planning CT (pCT). These daily doses were propagated to the pCT and