the only OARs to be significantly affected by applying these moves and in these cases no clinically significant deviations were observed.

Conclusions: Variations in the factors investigated, do not correlate with tumour movement within DIBH. The diaphragm is not stable within BH. Applying soft tissue moves is safe to surrounding OARs once due clinical attention is paid to close critical structures.

EP-1657
Inter-observer variability study for daily CBCT registration of VMAT prostate treatment
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Purpose/Objective: This work evaluated the inter-observer variability in CBCT registration for prostate patients treated with IMRT (Intensity Modulated Radiation Therapy). We also demonstrated the importance of daily CBCT registration for this treatment.

Materials and Methods: In the first study VMAT plans were produced for 2 prostate cancer patients and a voluntary shift of the isocenter was introduced in the anterior/posterior direction. A total of 22 different VMAT plans were evaluated with 13 plans for the first patient and 9 plans for the second. In the second study, 12 technologists each registered 22 CBCT for 22 different prostate patients. Medical doctors have done the same registrations that was considered as the Gold Standard reference. Registration was done using bony anatomy and adjustments made on by the user on evaluation of the rectum and prostate. Shifts in all three axis were documented for a total of 286 CBCT. Two statistical methods were used to analyse the results. The first was the 95 percentile to calculate the minimum threshold under which the users found similar values. The second was the ANOVA test, followed by the Post-Hoc/Bonferroni test. These tests were used to find differences in inter-observer registration variability and determine whether any individual users performed registrations which differed significantly from those of the other users.

Results: The dosimetric study showed that a shift of 5 mm in the posterior direction was enough to deliver a higher dose than acceptable to the rectum in both cases. A different threshold was found by shifting anteriorly, ranging from 5 to 10 mm in both patients A. On the other hand, the statistical analysis of the registration study showed that using the 95 percentile, threshold values were demonstrated of 2.1, 3.5 and 7.3 mm in the left/right, target/gun and anterior/posterior respectively. The Anova test showed a low p-value in the target/gun axis but using the Post-Hoc analysis there were no significant differences between the technologists and the medical doctors.

Conclusions: This study showed the importance of a daily CBCT/CT registration in prostate radiation treatment. The different studies also showed that partial delegation of the prostate registration fto the technologists is feasible under some security thresholds. However, regular training and evaluation should be done by the medical doctors and physicists.

EP-1658
The need for quality assurance of the image guidance process in radiotherapy
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Purpose/Objective: A higher awareness of changing anatomy has resulted in an increased complexity and a continuous change of the image guided radiotherapy (IGRT) process. To guarantee the quality of this process we developed a quality assurance (QA) program which involves 1) Inspection of the clinical IGRT process; 2) A check to assess if certain structural abnormalities occur in specific patient groups. This study describes the methodology of our QA program and the results after the first 8 months.

Materials and Methods: Each member of the IGRT group performed QA tasks once a week for 4 hours. A checklist was used to assess whether the IGRT process was performed according to protocol and to verify whether there were other abnormalities present. This checklist was developed within an interdisciplinary group discussion. Results of the QA program were documented in an in-house developed computer program.

The following items were monitored: 1) The number of errors in the IGRT preparation and execution process. 2) Anatomical and other potential dose altering changes that occurred during treatment. Monthly, results were discussed with the members of the IGRT group and, if necessary, feedback is given to the department. After the first 8 months, all QA findings were presented on a departmental level.

Results: In an 8 month period 5 dedicated RTTs, all IGRT working group members, reviewed 154 patients with a total of 609 CBCTs, including breast, lung, rectum, oesophagus, gynaecological, bladder and central nervous system patients.

- In 12% of the patients (n=43) anatomical changes were found, mainly in patients treated for lung or oesophagus cancer. 3% of the whole reviewed population needed replanning during treatment.
- 7.2% of the patients showed a change in body contour larger than 1 cm because of weight difference or seroma change.
- 17% of the patients showed irregularities in the IGRT preparation process. E.g. registration areas, defining the correct clipbox, correction reference point or match algorithm, were not defined according to protocol. These figures gave us a better insight regarding the IGRT process.
- In 3% of all the CBCTs rotation values were more than 4 degrees (the upper limit for acceptable rotations) the majority (77%) around the left-right axis.
- In 1.6% of the CBCTs a part of the CTV was outside the PTV as a result of tumor progression, tumor shift, or changes in seroma.
- 5 patients showed undetected lesions in the lung. In 2 patients after further examination these proved to be malignant.

Conclusions: The results of the QA program indicates that a substantial part of the treated population show changes which potentially alter dose delivery. In 3% of the investigated population rescanning and replanning was considered necessary.
Furthermore the results of the QA program did give us insight in the IGRT protocol. Based on the data, we have decided to create and perform a training program for all RTTs working on the linear accelerators.

**EP-1659**

Regions of interest analysis of setup uncertainties for post-mastectomy radiotherapy

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**Purpose/Objective:** Post-mastectomy radiotherapy (PMRT) reduces the recurrence rate of breast cancer patients, and the image-guide radiotherapy (IGRT) can reduce the setup uncertainties to approve the accuracy of dose delivery. In this study, we evaluate two different registration regions of cone-beam computed tomography (CBCT) to assess setup uncertainties for post-mastectomy radiotherapy.

**Materials and Methods:** All patients were positioned on the vacuum bag. After the weekly CBCT for IGRT, two regions of interests (ROI): A-breast region only (the square extend 3 cm from PTV boundary, the yellow rectangle in figure 1) ; B-entire body (include spine & contralateral rib, the white rectangle in figure 1) for CBCT image registration were applied on the bony alignment software (Elekta Synergy XVI 4.5.1) to compute the setup shifts value of X, Y, and Z directions. Group mean μ, systematic error Σ (standard deviation of group mean), random errors σ(root-mean-square of random shift), and setup margin(2.5Σ+ 0.7σ) were calculated for all translations. Pearson correlation coefficients R and Pair-T test of breast region shift verse entire body registration along all translational directions. Group mean μ, systematic error Σ (standard deviation of group mean), random errors σ(root-mean-square of random shift), and setup margin(2.5Σ+ 0.7σ) were all listed in table 1. The estimated setup uncertainties for post-mastectomy radiotherapy.

**Results:** Fourteen breast cancer patients were enrolled in a retrospective study and 86 weekly CBCTs were analyzed. The μ, Σ, and σ were all listed in table 1. The estimated setup margins of breast region groups were slightly bigger than those of entire body and ranged between only 0.38-0.88 mm. The correlation coefficient results show there are high consistence in all translations(Rμ=0.986;RΣ=0.930;Rσ=0.783, p=0.001). The Pair-T test shows the difference on each direction (diffμ=-0.0007±0.074,p=0.931; 
diffΣ=0.054±0.162, p=0.003;diffσ=-1.116±0.159,p=0.001).

<table>
<thead>
<tr>
<th>Unit : cm</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Breast</td>
<td>Entire</td>
<td>Breast</td>
</tr>
<tr>
<td>Group mean</td>
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<td>-0.017</td>
<td>0.029</td>
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<tr>
<td>Systemic error</td>
<td>0.239</td>
<td>0.224</td>
<td>0.172</td>
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<tr>
<td>Random error</td>
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<td>0.448</td>
<td>0.423</td>
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<tr>
<td>Margin</td>
<td>0.911</td>
<td>0.873</td>
<td>0.727</td>
</tr>
<tr>
<td>Correlation</td>
<td>0.996  (p&lt;0.001)</td>
<td>0.950  (p&lt;0.001)</td>
<td>0.783  (p&lt;0.001)</td>
</tr>
<tr>
<td>Difference</td>
<td>-0.0007(0.07p&lt;0.951)</td>
<td>0.054(0.001)</td>
<td>-1.116(0.15p&lt;0.001)</td>
</tr>
</tbody>
</table>

Conclusions: In this study, the discrepancy between different registration ROI selections was significant on Y and Z directions, but it can be ignored since the value was very small (Margin difference < 0.088 cm). It might be attributed to that the chest walls of PMRT patients were thin, and the PTVs covered most part of bony structure, so it’s similar to the entire body bony alignment registration. These relative positional variations could be less considered when making setup corrections by different operators and registration ROIs.

**EP-1660**

Interfraction Internal Target Volume dose coverage in Stereotactic Body Radiotherapy for infradiafragmatic tumor

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**Purpose/Objective:** Infradiafragmatic tumors can be treated with Stereotactic Body Radiotherapy (SBRT). The movement of the lesions can be taken into account designing an Internal Target Volume (ITV) which frames different Gross Tumor Volumes (GTV). This ITV could be modified in several treatment fractions, affecting the dose coverage. Our objective was to analyze interfraction changes in the ITV and the prescribed dose coverage.

**Materials and Methods:** We analyze 14 patients and 15 treated tumoral lesions. Simulation: fusion of three CT studies in different respiratory phases (normal breathing, inspiration, expiration) was done for the planification and for each fraction of treatment. Immobilization devices for stereotactic conditions were used: vacuum mattresses, prostep system for legs. Three GTV were delineated and one ITV was designed to frame the boundaries of the three GTV. Margin of 5mm was added to the ITV for the Planning Target Volume (PTV). 3D planning was performed with Pinnacle System software (Phillips). One planning was designed before the first fraction (ITV_0_planning) and it was applied in every new volume designed for the other fractions and modified if necessary, resulting one ITV for each fraction (ITV_1; ITV_2...). For the ITV coverage analysis and dosimetry we selected the 98% of the total prescribed dose. SBRT treatment was delivered with linear accelerator CLINAC 2100 (Varian). Verifications were done in each fraction with Portal Vision images and cine mode.

**Results:** The numbers of fractions administered were: 1 fraction in 8 cases; 3 fractions in 6 cases; 5 fractions in 1 case. Interfraction interval time was: minimum 24 hours, maximum 48 h.

**Interfraction ITV variations:** fig.1