adjacent structures. For these patients a mask was created from the GTV by a 2cm expansion after which the GTV itself was removed (figure C,D), effectively registering the adjacent structures. This method was evaluated on five weekly fractions of 24 patients. The second method was applied on patients with a non-attached tumor. In this method the local rigid registration was expanded by a scaling factor such that the regressing tumor in the CBCT was magnified to the original size of the tumor of the reference CT-scan during the registration (figure G,H). This method was applied on 5 patients and also five weekly fractions were evaluated. Bland-Altman analysis was applied to quantify the limits of agreement between these registration methods and the clinically approved registrations. All automatic registrations were visually validated to assess the success rate. 

Results: The limits of agreement between the registration method for regressing tumors attached to surrounding structures showed limits of agreement with the clinical method of -2.6—2.9mm for the LR direction, -2.9—2.8mm for the CC direction and -3.1—3.2mm for the AP direction. The alignment differences between these two methods were 1.3 (LR), 1.4 (CC) and 1.4 mm (AP) systematically and 1.0, 1.1 and 1.2mm randomly. This automatic method had a success rate of 91%.

The limits of agreement between the registration method for non-attached tumors and the clinical method were larger with -6.0—4.1mm (LR), -8.5—7.1mm (CC) and -3.3—4.3mm (AP). The alignment differences between these two methods were 4.0 (LR), 3.9 (CC) and 3.6mm (AP) systematically and 4.0, 3.3 and 2.4mm randomly. The success rate of these automatic registrations was 100%.

Conclusions: The registration method developed for regressing tumors attached to surrounding structures proved to be a reliable method for automatic tumor registration. The registration method for regressing non-attached tumors is promising but needs further investigation on a larger patient cohort.

Figure 1: Examples of clinical registration with (A,E) and without (B,F) shaped region of interest. Registrations tailored to regressing tumors with (C,G) and without (D,H) shaped region of interest. Figures A-D illustrate a tumor in an adjacent structure. Figures E-F illustrate a non-attached tumor.

OC-0077
Are pitch and roll compensations required in all pathologies? A data analysis of 2945 fractions
A. Gaudino1, P. Mancosu1, F. Lobefalo1, G. Maggi1, V. Palumbo1, G. Reggiori1, M. Scorsetti2, A. Stravato1, S. Tomatis1
1Humanitas Cancer Center, Medical Physics Unit of Radiotherapy, Rozzano (Milan), Italy
2Humanitas Cancer Center, Radiotherapy and Radiosurgery, Rozzano (Milan), Italy

Purpose/Objective: Nowadays, new linear accelerators can be equipped with a 6D robotic couch, providing two additional rotational motion axes: pitch and roll. We have evaluated the clinical efficacy of a 6D Robotic couch-top in CBCT image-guided radiotherapy (IGRT) over the first 6 months usage of the new EDGE linac (Varian). The data were analyzed in order to classify the pathologies for which the pitch and roll compensations could play a crucial function.

Materials and Methods: The couch compensations of 2945 fractions from 376 patients treated on the PerfectPitch 6 degrees of freedom couch were analyzed. Of these patients, 169 were brain, 114 lung, 54 liver, 26 pancreas, and 16 prostate. During setup, the patient anatomy from planning CT was aligned to the kV-CBCT and the 60 movements were executed. Information related to pitch and roll were extracted by proper querying of the Microsoft SQL server ARIA database where all the couch displacements are automatically stored. Mean values and standard deviations were calculated for all regions. Kolmogorov-Smirnov (KS) and two tail t-student tests were performed to verify the normal distribution and the significance of the differences, respectively.

Results: Considering all the data, mean pitch and roll adjustments were: -0.10±0.92 and 0.12±0.96; while the mean absolutes values of both adjustments were 0.58±0.69 and 0.69±0.72 (p<0.01). Brain showed the highest mean absolute values with 0.73±0.69 and 0.80±0.78; while the lowest values were for pancreas with 0.36±0.47 and 0.49±0.58. T-test was significant for brain vs. liver, pancreas and prostate. Collective corrections greater than 0.5, 1.0, 2.0 were observed in, respectively, 79.8%, 61.0%, and 29.1% for brain; 56.7%, 39.4%, and 6.7% for pancreas. Table 1 reports all the data analysis. No significant differences for months, number of fractions, dose per fraction were found.

Table 1: Absolute pitch and roll corrections (mean ± st.dev.) for brain, lung, prostate, pancreas, liver. Collective corrections greater than 0.5, 1.0, 2.0 for the same regions are reported, too.

Conclusions: Adjustments in all six dimensions, including unconventional pitch and roll rotations, improve the image registration for all pathologies. In limited available resources we suggest to start the 6D robotic couch implementation on brain tumors. Relative to the manual corrections, the automated 6D robotic process increased the efficiency of alignment when pitch and roll corrections were warranted.

OC-0078
Impact of tumor invasion on seminal vesicles mobility in radiotherapy of T3b prostate cancer
M. Buijs1, L. Bergsma1, J. De Vries1, R. Kalisvaart1, F. Pos1, W. Heemrberg1, P. Remeriej1, U.A. Van der Heide1
1The Netherlands Cancer Institute - Antoni van Leeuwenhoek Hospital, Radiotherapy, Amsterdam, The Netherlands
2Academic Medical Center, Radiotherapy, Amsterdam, The Netherlands

Purpose/Objective: Fiducial markers are proven to be reliable to locate the prostate during radiotherapy. Several studies have shown however, that the seminal vesicles may move independently from the prostate corpus, which may undermine adequate coverage of tumor invasion in the seminal vesicles in marker based prostate IGRT. We hypothesize that the vesicles become more rigid in case of tumor infiltration and are thus adequately covered by marker based IGRT. The aim of this study was to assess the relationship between the progressiveness of tumor invasion in
the seminal vesicles and their mobility relative to the prostate corpus.

Materials and Methods: Based on clinical staging and pretreatment MRI scans 3 groups of 30 patients with T2a-3bN0M0 prostate carcinoma were formed. The first group consists of patients with no seminal vesicles invasion. The second group had minimal invasion, ≤ 5 mm measured from the prostate corpus on the MRI scans. The third group had (>5 mm) extensive invasion (figure 1).

Online fiducial markers registrations were performed in all patients on the first 8 cone beam CT scans to establish the prostate corpus translational and rotational errors. To measure the translational and rotational errors of the seminal vesicles, registrations were performed using a 3D shaped region of interest of the seminal vesicles and a grey value algorithm. Due to poor CBCT quality 106 out of 720 CBCT's were excluded.

The mean and SD residual seminal vesicles displacement was calculated for all three groups in LR, CC, AP direction and LR, CC, AP rotation. A spearman rho correlation test was performed to determine the relation between the invasion and the displacement of the seminal vesicles. The displacement of the seminal vesicles was compared between the groups for all directions using a Mann-Whitney test.

Results: We found a significant reduction in random seminal vesicle displacement with increasing tumor invasion in the LR (ρ=-0.263, p=0.012), CC (ρ=-0.297, p=0.04), AP (ρ=-0.333, p=0.001) direction and for the LR rotation (ρ=-0.260, p=0.013). The SDs of the residual seminal vesicles displacement were significantly different between the group with minimal invasion and the group with extensive invasion in the CC and AP direction and for the LR rotation, see table 1. Between the group with no invasion and the group with extensive invasion, a significant difference in residual seminal vesicles displacement was found in the LR, CC and AP direction and for the LR rotation. No significant differences were found between the two invasion groups and the minimal invasion group.

Conclusions: Although increasing tumor invasion in the seminal vesicles reduces the mobility of the seminal vesicles, the mobility of the seminal vesicles still remains considerable, even in case of extensive invasion. Therefore strategies, such as adaptive radiotherapy, are needed for adequate seminal vesicle coverage despite their reduced mobility.

<table>
<thead>
<tr>
<th>Direction</th>
<th>No vs. Minimal invasion</th>
<th>No vs. Extensive invasion</th>
<th>Minimal vs. Extensive invasion</th>
</tr>
</thead>
<tbody>
<tr>
<td>LR</td>
<td>0.025</td>
<td>0.015</td>
<td>0.053</td>
</tr>
<tr>
<td>CC</td>
<td>0.41</td>
<td>0.001</td>
<td>0.002</td>
</tr>
<tr>
<td>AP</td>
<td>0.39</td>
<td>0.002</td>
<td>0.007</td>
</tr>
<tr>
<td>LR rotation</td>
<td>0.036</td>
<td>0.011</td>
<td>0.024</td>
</tr>
<tr>
<td>CC rotation</td>
<td>0.000</td>
<td>0.703</td>
<td>0.432</td>
</tr>
<tr>
<td>AP rotation</td>
<td>0.234</td>
<td>0.896</td>
<td>0.317</td>
</tr>
</tbody>
</table>

Table 1: Results of the comparison of the seminal vesicles displacement between groups with increasing seminal vesicle tumor invasion.

Dynamic tumor tracking with the Vero4DRT system using a single fiducial marker for early stage lung cancer

C. Collen1, C. Poels1, T. De Vin1, B. Engels1, M. Boussaer1, G. Storme1, D. Verellen1, M. De Ridder1

1Universitair Ziekenhuis Brussel, Radiotherapy, Brussels, Belgium

Purpose/Objective: Dynamic tumor tracking (DTT) requires a fiducial as surrogate for tumor position. Clinical results applying multiple spherical gold markers, placed around the tumor using a bronchoscope, were reported previously (1). We report on the use of a single fiducial marker placed inside the tumor percutaneously.

Materials and Methods: A prospective phase II trial was initiated using a gimbaled linac for stereotactic radiosurgery of early stage lung cancer (NCT 02224547). If tumor motion on 4DCT exceeded 8 mm, patients were eligible for DTT and a single fiducial marker (Visicoil, IBA, Louvain-la-neuve, Belgium) was implanted. Otherwise an internal target volume

OC-0079

CTV-to-PTV margin for treatment setup errors: paediatric vs adult

M. Nazmy1, E. O'Shea1, E. McCrickard1, C. O'Sullivan1

1St Luke's Radiation Oncology Network, Radiation oncology, Dublin, Ireland Republic of