PO-0943
Clinical comparison of 2D transabdominal and 3D transperineal ultrasound image guidance methods for prostate RT
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Purpose/Objective: Our clinic is a long-term user of a 1st generation trans-abdominal (TA) ultrasound image guidance (USIG) system (BAT, Best Nomos Inc) for prostate cancer treatments. We are also an early adopter and development partner for a new, second generation 3D USIG system (Clarity, Elekta Inc), which allows for trans-perineal (TP) localization and intra-fractional tracking of the prostate. This new system has been evaluated at our institution, by direct comparison with the previously established TA method for prostate alignment.

Materials and Methods: Patients were positioned according to routine clinical protocol and aligned to skin marks using treatment room lasers. TP USIG was performed and TP shifts from tattoo were performed and recorded prior to performing TA USIG for verification purposes only. The observed differences of TA USIG from TP shifts were recorded. A total of 569 fractions delivered to 30 prostate cancer patients were thus analyzed for agreement between the two USIG systems. For each patient, a graph and tables showing shift of skin marks to TP USIG and agreement between the USIG systems of all applicable fractions were generated.

Results: The mean TP-based initial shift from tattoo was -1.78, -0.27, and -2.36 mm in left-right (LR), anterior-posterior (AP), and superior-inferior (SI) directions, respectively. The average difference (AD) between the two USIG systems was -0.06, -0.05, and -0.02 mm in LR, AP and SI directions respectively. The respective standard deviations of the AD were 0.19, 0.45 and 0.38 mm. Image 1 shows a sample of patients, with the dot representing the mean agreement between the USIG systems for a patient. The error bars represent the patient specific standard deviation.

Conclusions: Data evaluated here, which includes the initial competency development period for the new TPUS acquisition approach in our clinic, showed the average difference between TPUS and TAUS, across all 569 fractions evaluated here as less than 1 mm in the three principle directions (LR, AP, SI). There was no systematic difference found between the two systems. In addition to superior image quality, a prime observed advantage of the TP USIG approach was the intra-fraction tracking capability.

PO-0944
Radiotherapy QA of the DAHANCA 19 protocol
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Image 1: Agreement of prostate localization for two USIG systems.

Conclusions: Data evaluated here, which includes the initial competency development period for the new TPUS acquisition approach in our clinic, showed the average difference between TPUS and TAUS, across all 569 fractions evaluated here as less than 1 mm in the three principle directions (LR, AP, SI). There was no systematic difference found between the two systems. In addition to superior image quality, a prime observed advantage of the TP USIG approach was the intra-fraction tracking capability.
Purpose/Objective: It has been demonstrated that non-adherence to protocol-specified radiotherapy (RT) requirements is associated with reduced survival, local control and potentially increased toxicity [1]. Thus, quality assurance (QA) of RT is important when evaluating the results of clinical trials. RT-QA of large multicentre-trials, however, requires substantial effort and resources. Recently, we presented a digital QA platform, the CIRRO dose plan bank, which allows for central review of such trials. Here, we present our RT-QA results from the latest completed clinical protocol from the Danish Head and Neck Cancer Group (DAHANCA).

Materials and Methods: The clinical results of the DAHANCA 19 randomized phase III trial evaluated the effect of concurrent EGFR-inhibition during primary curative (chemo) radiotherapy in patients with head and neck squamous cell carcinoma (HNSCC). A total of 504 Danish patients entered the protocol in 2007-2012. Patients received RT at 5 different oncology centers to a total dose of 66-68Gy, 2Gy/fx, 6 fx/week. For the current QA analysis, total treatment time, CTV coverage, and near-max doses to the spinal cord and brainstem including the corresponding planning risk volumes (PRVs) were evaluated according to 2004 DAHANCA guidelines. Each QA parameter was scored within three categories: 1) Full compliance to protocol guidelines, 2) Minor deviations: Not according to guidelines, but without clinical relevance, and 3) Major deviations: Clinical significant deviation. Categories 1) and 2) are clinical acceptable, whereas category 3) is clinically unacceptable.

Results: The complete digital RT dataset was uploaded for all 504 patients and QA parameters were extracted. The results are shown in table 1. Not all patients contribute to the PRV data, since the PRV concept was introduced in the Danish clinics shortly after 2007. Furthermore, 13 patients (2.6%) were eliminated from the CTV QA due to challenges to extract dose summations (e.g. re-scans and primary/ boost dose plans) from the database. A total of 11 major deviations were recorded. Four major deviations in CTV1 dose coverage were due to clinical considerations of the tolerance dose to the spinal cord, thus compromising target dose. Five of the major deviations in total treatment time were related to comorbidities, such as alcohol- or cardiac related matters and hospitalization. The remaining two cases were due to tracheotomy procedures and subsequent re-scans, which delayed the RT course.

<table>
<thead>
<tr>
<th>RESULTS</th>
<th>No. of patients</th>
<th>Full compliance</th>
<th>Minor deviation</th>
<th>Major deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total treatment time</td>
<td>504</td>
<td>98.9%</td>
<td>9.2%</td>
<td>1.4%</td>
</tr>
<tr>
<td>Spinal cord</td>
<td>504</td>
<td>97.4%</td>
<td>2.6%</td>
<td>0.9%</td>
</tr>
<tr>
<td>Spinal cord PRV</td>
<td>438</td>
<td>97.5%</td>
<td>2.5%</td>
<td>0.9%</td>
</tr>
<tr>
<td>Brainstem</td>
<td>501</td>
<td>99.9%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Brainstem PRV</td>
<td>334</td>
<td>99.7%</td>
<td>0.3%</td>
<td>0.0%</td>
</tr>
<tr>
<td>CTV1</td>
<td>493</td>
<td>93.9%</td>
<td>5.3%</td>
<td>0.8%</td>
</tr>
</tbody>
</table>

Table 1: Summary of results from RT-QA of the DAHANCA protocol.

Conclusions: RT dose plans in DAHANCA 19 adhere well to national clinical guidelines. A total of 11 major deviations were found in 504 patients. All majors were clinically well accounted for.


PO-0945
A method for fast dose re-evaluation on Elekta CBCTs as decision tool for adaptive RT in lung cancer patients
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Purpose/Objective: During lung cancer radiotherapy, anatomical changes are frequently observed on cone-beam CT scans used for position verification and adaptive replanning might be needed without prolongation of overall treatment time. A method for fast re-evaluation of the dose distribution on small FOV CBCTs was developed. The influence of anatomical changes on the dose distribution was evaluated in a group of lung cancer patients.

Materials and Methods: In 13 lung cancer cases a CBCT (Elekta XVI) and a repeat planning CT (Philips Brilliance) were obtained on the same day to ensure identical anatomy. The CBCT was registered on the repeat CT, which in turn was registered to the original planning CT according to the clinically applied patient shift. The original treatment plan and delineated structures were transferred to the repeat CT and CBCT to recalculate the dose. Dose calculation on the CBCT was done in Pinnacle3 v9.6 (Philips) by (1) adding the remainder of the body contour missing on the CBCT by taking the body contour of the planning CT with a density override equal to one; (2) Overriding the density of the CBCT outside the patient to 0; (3) Deriving a patient-specific HU-to-density table by comparing CT values of corresponding points on the CBCT and original planning CT; (4) Recalculating the dose using the individualised HU-to-density table and a standard table for XVI lung scans. Clinically relevant dose parameters were compared to assess the accuracy of this approach. The impact of anatomical changes on the dose distribution was evaluated.

Results: In all clinical cases the CBCT could be successfully registered on the repeat CT, and only minor differences in the anatomy were visible. A complete dose evaluation could be performed in ~ 10 minutes. GTV and PTV coverage, the dose to the lungs (V150% MLD), oesophagus (mean dose, V150%), spinal cord (max dose) and heart (mean dose) were scored for the repeat CT and CBCT dose calculation. Figure 1 displays the average and standard deviation (error bars) of the absolute relative difference of the dose metrics between repeat CT and CBCT, both using a standard HU-to-density table for the CBCT lung XVI protocol, as well as a patient-specific table. A good agreement between the dose distributions recalculated on CBCT and repeat CT was observed for most patients when a patient-specific HU-to-density table was used. Compared to the planning CT, the observed dose differences did not necessitate plan adaptation in 10 of the 13 cases, as the target coverage was sufficient and tolerance levels of the OARs were not exceeded. Three cases with tumour shifts leading to an insufficient coverage of the target were replanned.