PO-0879  
Short course PET based SIB for cervical cancer  
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Purpose/Objective: State of the art treatment of locally advanced cervical cancer with image guided intensity modulated external radiotherapy followed by image guided brachytherapy provide good clinical outcome. However, there are still 10-15% loco-regional failures and 10-20% who experience moderate to severe side effects. In the current work we propose to use FDG PET as basis for a short-course simultaneous integrated boost (SIB) with external beam therapy. This may increase tumour control and improve tumour shrinkage before brachytherapy. The latter may reduce complexity and improve organ sparing at brachytherapy.

Materials and Methods: This study included 10 patients with locally advanced cervical cancer all treated with curative image guided external beam and brachytherapy. FDG PET/CT was obtained prior to therapy for all patients. To explore the potential use of PET based dose escalation, a new approach was tested in silico. Here, the FDG avid tumour volume was dose escalated by intensity modulated radiotherapy from the conventional 1.8Gy to 2.8Gy per fraction for the first 10 fractions; a short-course SIB. For the remaining 18 external beam fractions, standard treatment to the pelvic area is followed to a total dose to the PTV and boost volume of 50.4Gy and 60.4Gy, respectively. For intensity modulation, both photons and protons were considered using dual arc VMAT and three-field IMPT, respectively. All treatment plans were generated using the Eclipse Treatment Planning System (v.11, Varian Medical Systems, Palo Alto, CA).

Results: For the patients included, the PET based boost volume had a mean volume of 36 ± 6cm³ as compared to average volumes for the GTV and PTV of 69 ± 10cm³ and 1508 ± 55cm³, respectively. The dose escalation was straightforward to implement for both VMAT and IMPT, with a D95 ≥ 95% for the boost volume being achieved in all cases. The sum of the short-course SIB (10 fractions) and the subsequent 18 conventional fractions was compared to the conventional, 28-fraction non-SIB approach by analysing dose volume histograms (Table 1). Only marginal increased doses to the relevant organs at risk (OARs) were found for all investigated parameters. IMPT had, compared to VMAT, reduced OAR doses in the intermediate dose range, but showed no relative advantage in dose escalation.

Table 1 DVH analysis of conventional treatments vs short course SIB

<table>
<thead>
<tr>
<th>Modality</th>
<th>Bladder</th>
<th>Rectum</th>
<th>Bowel</th>
</tr>
</thead>
<tbody>
<tr>
<td>VMAT</td>
<td>90.26%</td>
<td>75.61%</td>
<td>12.01%</td>
</tr>
<tr>
<td>SIB</td>
<td>90.61%</td>
<td>76.51%</td>
<td>12.56%</td>
</tr>
<tr>
<td>IMPT</td>
<td>93.21%</td>
<td>72.31%</td>
<td>11.41%</td>
</tr>
</tbody>
</table>

Conclusions: The additional 1Gy per fraction to the boost volume could be achieved in all patients with only minor increase of OAR dose using both VMAT and IMPT. This short-course approach may prove beneficial in terms of reduced impact of anatomical changes during dose escalation and allowing time for enhanced tumour shrinkage before brachytherapy. Thus, this novel concept may prove clinically valuable, in particular for patients with large tumours.

PO-0880  
MC dose calculation for protons - evaluation of plan quality and translation into clinical practice  
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Purpose/Objective: To investigate the influence of Monte Carlo (MC) dose calculation settings on the proton dose distribution. Different phantom geometries and patient cases were evaluated with focus on dose calculation accuracy and clinical applicability including benchmarking against pencil beam (PB) calculations.

Materials and Methods: MC calculation settings like maximum number of particles (5x10^8-5x10^10), mean relative statistical uncertainty per spot (MRSU = 1-5%) and the MRSU threshold (th) (10-60% of maximum dose per spot) for voxels included in uncertainty considerations were tested for a proton MC algorithm (XiO research version v4.62, Elekta AB, Stockholm, Sweden). The clinically used PB algorithm including heterogeneity corrections, nuclear interactions and energy dependent stopping power ratios was used for benchmarking. All plans were optimized with the PB and recalculated using the MC algorithm. The phantom consisted of 10 chess pattern cubes of 10x20x9.6 mm³ with alternating HUs of +1000 (bone) and -800 (lung) embedded in a water tank. Target structures were located within or at varying distances behind the chess pattern and irradiated from different directions. A prostate (2 opposing beams) and a paranasal sinus (PS) cancer patient (3 beams) served as clinical test cases. The results were evaluated by means of dose difference maps, γ-index analysis (2%/2mm), homogeneity (HI), conformity (CI) and dose volume measures.

Results: For an accurate dose calculation up to 5x10^9 particles were required using a MRSU of 3-5% and up to 5x10^10 for under 3%. γ-index analysis (PB dose as reference) for plans with a beam entrance angle of 15% revealed a γmax of 0.5 and γ95 of 3.2, with a failure rate of 13.7% in an area of 3 cm around the target (Figure 1a). For targets distal to the chess pattern the main factor influencing dose differences was the distance to the inhomogeneities. The CI was 0.84 for the PB and 8.3% less for the MC at a distance of 1 cm, irrespectively of the settings. At 3 cm distance negligible differences were found between MC and PB.

Dose calculation for a prostate plan lasted 21 s for the PB algorithm. For MC the dose calculation time was higher by a factor of 4 (MRSU = 5%) and 78 (MRSU = 1%). D95 and the HI increased from 102% to 104% and 0.09 to 0.12 using MC instead of PB. These differences showed a decreasing tendency for more accurate MC settings. For the PS patient the heterogeneous tissue in the brain together with the