Intraoperative placement and measurement
dosimetry of RIC-100 require careful setup due to steep dose gradients. Physical source dimensions should be chosen carefully based on treatment site dimensions, and air-gaps between source and target should be minimized, to prevent under-dosing the target in the lateral extent. Radiological scaling should be used to calculate expected dose when non-water materials are used in experimental measurements, such as calibration or depth dose.

EP-1990
Comparison of dose optimisation methods for vaginal HDR brachytherapy with multichannel applicators
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Purpose or Objective: Multichannel Vaginal Cylinders (MVCs) allow to perform conformal HDR brachytherapy (BT) treatments for vaginal vault cancers. Despite the fact that with MVCs the degrees of freedom for treatment planning have significantly increased with respect to common vaginal cylinders, no unique indications are currently given on how to perform dose distribution optimization. Purpose of this study was to compare several optimization methods (OM) implemented in Oncentra Brachy (Nucletron Elekta), with a particular attention to the target coverage and the simultaneous limitation of hot spots to the vaginal mucosa and the improvement of dose homogeneity to the target.

Material and Methods: The study was based on 12 vaginal cancer cases treated with HDR BT (25Gy/5 fractions) as boost after external beam radiotherapy (45Gy/25 fractions). MVC applicators with diameters of 25mm (6 cases) and 30mm (6 cases) were used and treatments were retrospectively planned using four OM: i) a combination of geometrical and graphical OM (GR); ii) the Inverse Planning by Simulated Annealing (IPSA) method, imposing surface dose constraints on the PTV (surfIPSA); iii) the IPSA method, applying further dose constraints to the applicator surface (homogIPSA); iv) the Hybrid Inverse Planning Optimization (HIPO) with previously defined iterative optimization steps. All methods had to respect constraints on bladder and rectum (respectively D2cc-80% and D2cc-75% of the prescribed dose), and to possibly deliver at least a V90-95% to the PTV. Plans evaluation was performed in terms of PTV coverage (D90, V90), conformity index (CIN), dose homogeneity index (DHI) and ratio between source dwelling times in the central and peripheral catheters (%CC). As maximum dose to the
vaginal mucosa the D0.1cc was considered. Statistical significance of the results was proven by a Wilcoxon test for paired samples (significant p-value <0.05)

Results:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>GV90 (%)</th>
<th>Stx/IFPSA</th>
<th>homogIPSA</th>
<th>HIPO</th>
</tr>
</thead>
<tbody>
<tr>
<td>V90 (%)</td>
<td>95.46 ± 4.20</td>
<td>93.55 ± 6.62</td>
<td>95.63 ± 3.95</td>
<td>95.19 ± 4.21</td>
</tr>
<tr>
<td>D90 (%)</td>
<td>100.05 ± 5.32</td>
<td>97.99 ± 18.28</td>
<td>95.92 ± 6.35</td>
<td>96.79 ± 6.30</td>
</tr>
<tr>
<td>D95 (%)</td>
<td>94.90 ± 9.13</td>
<td>87.65 ± 14.18</td>
<td>89.13 ± 13.35</td>
<td>87.69 ± 8.20</td>
</tr>
<tr>
<td>COIN</td>
<td>88.61 ± 9.09</td>
<td>79.06 ± 10.99</td>
<td>84.16 ± 10.06</td>
<td>86.84 ± 0.06</td>
</tr>
<tr>
<td>(D_{\text{mean}}) (%)</td>
<td>58.17 ± 13.66</td>
<td>57.10 ± 11.31</td>
<td>57.51 ± 13.09</td>
<td>57.76 ± 13.02</td>
</tr>
<tr>
<td>(D_{\text{mean}}) (Gy)</td>
<td>73.52 ± 22.22</td>
<td>72.47 ± 4.14</td>
<td>72.64 ± 4.11</td>
<td>72.88 ± 4.46</td>
</tr>
<tr>
<td>(D_{\text{mean}}) (%)</td>
<td>249.27 ± 36.35</td>
<td>259.09 ± 45.45</td>
<td>269.81 ± 44.63</td>
<td>254.76 ± 49.02</td>
</tr>
<tr>
<td>CCN</td>
<td>0.33 ± 0.21</td>
<td>0.45 ± 0.20</td>
<td>0.61 ± 0.12</td>
<td>0.80 ± 0.10</td>
</tr>
</tbody>
</table>

Table 1 shows the obtained values of target coverage (D90 and V90) and bladder and rectum sparing (D2cc).

The figure shows average DVHs of the PTV over all 12 cases. DVHs obtained with homogIPSA and HIPO show a steeper gradient, resulting in smaller volumes exposed to high doses. homogIPSA and HIPO result in significantly better values of COIN, D95 and %CC for the investigated OM. No significant differences resulted among the OM in terms of target coverage (D90 and V90) and bladder and rectum sparing (D2cc).

Conclusion: HIPO and homogIPSA should be preferred due to their ability to get improved dose homogeneity to the target and reduced hot spots to the vaginal mucosa. This is achieved by a more effective distribution of source dwelling times between central and peripheral catheters. It has to be noted that all investigated OM require experience of the planner and are not completely user independent.


The dosimetric characteristics of GMS BT-125-1 I-125 radioactive seed

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Purpose or Objective: To investigate the dosimetric characteristics of GMS BT-125-1 I-125 radioactive seed, including dose rate constant, radial dose functions and anisotropy functions.

Material and Methods: Dosimetric parameters of GMS BT-125-1 I-125 seed, including dose rate constant, radial dose functions and anisotropy functions were calculated using the Monte Carlo code of MCNP5, and measured using thermoluminescent dosimeters (TLDs). Monte Carlo calculations were also performed for the PharmaSeed BT-125-1 I-125 seed, PharmaSeed BT-125-2 I-125 seed and model 6711 I-125 seed. The dosimetric parameters of GMS BT-125-1 I-125 seed were compared with those of PharmaSeed BT-125-1 I-125 seed, PharmaSeed BT-125-2 I-125 seed and model 6711 I-125 seed. The measured results were compared with those of Monte Carlo simulation for GMS BT-125-1 I-125 seed.

Results: The MCNP5 calculated dose rate constant of GMS BT-125-1 I-125 seed was 1.011 . The experimental measured dose rate constant of GMS BT-125-1 I-125 seed was 0.967 . For radial dose function, the difference between GMS BT-125-1 I-125 seed and PharmaSeed BT-125-2 I-125 seed were typically less than 2.0% with a maximum of 3.3%. The largest differences were 8.1% and 6.2% compared with PharmaSeed BT-125-1 and model 6711 I-125 seed, respectively. For anisotropy functions, the difference between GMS BT-125-1 I-125 seed and PharmaSeed BT-125-2 I-125 seed was typically <10% with a maximum of about 9.6% when the polar angle was larger than 10 degree, and 22.9% when the polar angle was smaller than 10 degree. Compared with Monte Carlo simulation, the largest differences of radial dose functions and anisotropy functions were 14.5% and 29.1%, respectively.

Conclusion: The measured dose rate constant, radial dose functions and anisotropy functions for GMS BT-125-1 I-125 seed showed good agreement with Monte Carlo calculated values. The dosimetric parameters of GMS BT-125-1 I-125 seed are similar to those of PharmaSeed BT-125-1 I-125 seed.

EP-1992

Design and characterization of a new HDR brachytherapy Valencia applicator for larger skin lesions

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Purpose or Objective: The aim of this study was: (i) to design a new high-dose-rate (HDR) brachytherapy applicator for treating surface lesions larger than 3 cm in diameter and up to 5 cm size, using the microSelectron-HDR afterloader (Elekta Brachytherapy); (ii) to calculate by means of the Monte Carlo (MC) method the dose distribution around the new applicator when it is placed over a water phantom; and (iii) to validate experimentally the water dose distributions.

Material and Methods: The new applicator is made of tungsten, and consists on a set of interchangeable collimators without flattening filter. It makes use of three catheters to allocate the source at prefixed dwell positions and times to produce a homogeneous dose distribution at 3 mm depth in the water phantom. The Penelope2008 MC code was used to optimize dwell positions and dwell times. Next, the dose distribution in a water phantom and leakage dose distribution were calculated. Finally, MC data were validated experimentally by measuring: dose distributions with radiographic EBT3 films (ISP) for an 192Ir mHDR-v2 source; percentage depth-dose (PDD) curve with the parallel-plate ionization chamber Advanced Markus (PTW); and absolute dose rate with EBT3 films and the PinPoint T31016 (PTW) ionization chamber.

Results: PDD and off-axis profiles were obtained normalized at a depth of 3 mm along the central applicator axis in a cylindrical water phantom. These data can be used for treatment planning. Leakage was also scored. The dose distributions, PDD, and absolute dose rate calculated agree within experimental uncertainties with the doses measured.

Conclusion: The new applicator and the dosimetric data provided here will be a valuable tool in clinical practice, making treatment of large skin lesions simpler, faster, safer, and with minimized dose to surrounding healthy tissues when