lead placed between the breast and the table. Thus, during the treatment, the breast rested over this lead shield. In addition, two lateral pieces of lead (3 cm thick each) were added. One of the lateral layers had a port through which the transfer tubes were connected to the catheters. The lateral blocks allowed placing an extra piece of lead (2.5 cm thick) above the breast, parallel to the first layer, aiming to reduce primary radiation to the thyroids and eye lenses. In addition, in order to minimize the transit dose when the 192Ir source exits and returns to the remote afterloader, a hollow lead tube was made, which covered the transfer tubes. Finally, a layer of water-equivalent material (1 mm thick) was placed between the slices of an anthropomorphic phantom modeling the patient. Dose variation as a function of distance from the implant volume as well as dose homogeneity within a representative slice of the fetal position was evaluated without and with shielding.

Results: When using the shielding, the peripheral dose decreased exponentially with the distance, and ranged from 50 cGy at 5 cm from the caudal edge of the breast to < 0.1 cGy at 30 cm. The shielding reduces absorbed dose by a factor of two near the breast and more than an order of magnitude beyond 20 cm. The dose is heterogeneous within a given patient axial plane, with measured variations from the central region within 50%. The fetal dose evaluated in this study with the designed lead shielding was compared with reported doses to the fetus from external-beam radiotherapy (6MV against head and lung).

Conclusions: Shielded HDR breast brachytherapy is a treatment option that may benefit pregnant patients needing localized radiotherapy, especially during the early gestational ages when the fetus is more sensitive to ionizing radiation.

EP-1591
Four approaches to estimate the foetus dose from radiotherapy with photon beams - a case example
C. Ramberg1, A. Balazs1, A.K. Winge-Main2, H.M. Olerud3
1Oslo University Hospital Norwegian Radium Hospital, Med. Physics, Oslo, Norway
2Oslo University Hospital Norwegian Radium Hospital, Oncology, Oslo, Norway
3Oslo University Hospital Norwegian Radium Hospital, Intervention centre, Oslo, Norway

Purpose/Objective: The purpose was to estimate the dose to the foetus in a case when a pregnant patient, 16 weeks after conception, were in need of stereotactic radiotherapy with 6MV against head and lung.

Materials and Methods: Four treatment plans, three for the brain metastasis and one for the lung metastasis, were available. The prescribed doses were 25 Gy x 1 fraction for the brain tumours and 15 Gy x 3 fractions for the lung. The photon energy spectrum in the position of foetus (about 32cm from lower field limit in the lung treatment) and the normalised dose (µGy/MU) in certain distances from the treatment volume were available from literature 1. Four different approaches for dose estimates were used: 1) based on measurements with ionisation chamber in an Alderson full body phantom, 2) tps data estimated from the scanned Alderson full body phantom (Oncentra v.4.3, Elekta), 3) measurements with TLD at the skin entrance during patient treatment and 4) based on literature.

Results: In table 1 are the different plans and measurements with ionisation chamber summarized. The measurements in Alderson were in total 40mGy, 34 mGy from the plan in the lung and the remaining from the brain-plans. The tps calculated the dose in Alderson from the lung-plan to 53mGy. TLD measurements showed 30mGy (no energy correction) and from literature the estimated dose became 60mGy (4x4cm² fields). In total the foetus dose was estimated to 40±10 mGy.
Conclusions: The measurement in Alderson phantom is presumed to give most accurate estimate, even though the real patient dimensions may differ. For situations where the first estimates indicate doses >100 mSv it should be considered to do a low dose CT scan of the patient and transfer to the dose planning system. When the distance from uterus to lower field limit is less than 20cm the dose planning system seems to be quite accurate. Such cases need to be carefully considered by the clinical team in the hospital; the patient and family members need evidence based medical advises in this difficult ethical dilemma. In this case there was no indication for abortus provocatus due to the radiation dose itself.

Reference:

Electronic Poster: Brachytherapy track: Breast

EP-1592
Experience with image-guided brachytherapy after oncoplastic breast surgery: method description and results
M. Soler-Tortosa1, D. Martínez-Rodríguez2, A. Camara-Turbí2, F. Candela-Rodríguez2, M. Estornell-Gualde1, T. García-Martínez2
1Hospital Universitario de la Ribera, Radioterapia, Alzira, Spain
2Hospital Universitario de la Ribera, Radiofísica y Radioprotección, Alzira, Spain

Purpose/Objective: Oncoplastic surgery has become more frequent in the last few years, because of excellent cosmetic results. Adjuvant radiotherapy procedures have to cope with breast tissue displacements in the postoperative target definition.

The purpose is to present our methodology for image guided HDR interstitial Brachytherapy of breast cancer, based on localize stereotactically the target volume and doing the implant image-guided to better fit its volume.

Materials and Methods: 20 breast cancer patients (10 T1 and 10 T2, median size 17.5mm) treated with post-operative image guided brachytherapy (IGBT), 19 were boost before external RT (18 cases 7Gy-1 session, and 1 case 5Gy-3 sessions), and one was exclusive treatment (4Gy-8 sessions).

Computed Tomography (CT) Phillips BrillianceTM, treatment planning systems (TPS) Pinnacle3 TM (external) and Elekta OncentraTM Brachy (brachytherapy), Linear Accelerator Varian Clinac™ 2100C/D, and HDR delivery system Elekta microSelectron™ with Elekta COMFORT™ Catheter Applicator System.

The starting point was a CT with the patient in a favorable position for the catheter implantation and fixed using a vacuum cushion for head and shoulders. Using Pinnacle3 as a virtual simulator two opposite beams were defined, collimated to the PTV, and with gantry angles that satisfy (figure below):
- Anatomically feasible geometry for the implant (possibility of covering the PTV without crossing with the needles the chest wall plus a 6mm margin)
- Minimum PTV section and exposed skin area, with the least healthy tissue crossed by needles (minimizing the number of catheters)

Also the length should be less than 20cm in every possible catheter path (maximum needle length). Depending on the BEV area, the number of catheters was decided.

A set of representatives points for the BEV perimeter were chosen, and their 3D coordinates registered (relative to the point marked by tattoos in the CT). Using the Clinac as a simulator, all these crouch displacements were made, and so all the points were marked on the skin. These marks were the guidance for the implant process (it enclosed the entrance & exit points). After the implant, a new CT was made to check the needle setting, allowing for corrections if there are PTV areas far from any needle (6mm). Finally, the treatment was planned with Oncentra™ Brachy, 3D criteria, and graphical optimization.

Results: The mean PTV size was 43.2cc and the mean number of catheters was 9. The dosimetric results were analyzed by some quality parameters:
- For the PTV the D90, homogeneity (DHI=1- V150/V100), and conformity index (RTOG-CI).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Median</th>
<th>Mean</th>
<th>Range</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTV (cc)</td>
<td>34.1</td>
<td>43.2</td>
<td>15 - 105</td>
<td>25.7</td>
</tr>
<tr>
<td>V50 (cc)</td>
<td>107</td>
<td>144.8</td>
<td>61.1 - 410.3</td>
<td>89.4</td>
</tr>
<tr>
<td>V100 (cc)</td>
<td>41.1</td>
<td>55.8</td>
<td>22.3 - 138.1</td>
<td>35.5</td>
</tr>
<tr>
<td>V150 (cc)</td>
<td>90</td>
<td>24.7</td>
<td>8.6 - 74.6</td>
<td>16</td>
</tr>
<tr>
<td>V200 (cc)</td>
<td>8.6</td>
<td>10.6</td>
<td>4.1 - 99.2</td>
<td>8</td>
</tr>
<tr>
<td>D90 (%Gy)</td>
<td>0.54</td>
<td>0.56</td>
<td>0.49 - 0.67</td>
<td>0.05</td>
</tr>
<tr>
<td>CI</td>
<td>1.39</td>
<td>1.43</td>
<td>1.05 - 2.18</td>
<td>0.34</td>
</tr>
</tbody>
</table>

Conclusions: We obtained good results for the CI and DHI parameters, keeping the V70% for OAR’s at clinically optimized levels.