K. Surmann was a lesser issue compared to the effect of the anatomical radiotherapy with the humeral head as PRV.

**Material and Methods:**
(Offersen Radiother Oncol. 2015) establish the humeral head for target delineation for elective breast radiotherapy.

**Purpose or Objective:**
Guidelines for sparing the humeral head in elective breast radiotherapy with level 1 and 2 (L1/L2) lymph nodes by connecting the humeral head PRV (hh+10) was included with an objective of V40Gy < 0.92. The doses to the OAR were comparable between the HTF and p = 0.01 compared to HTF and p = 0.19 compared to IMRT. The dose to the OAR increased as well. The mean dose to the contralateral breast increased significantly from 0.6Gy with HTF and IMRT to 2.3Gy with VMAT (p < 0.01 for both).

**Conclusion:**
Severe reductions in target dose coverage were observed as an effect of interfractional anatomical changes. The difference between the position verification methods was a lesser issue compared to the effect of the anatomical changes.

**PO-0847**
Implementing the new ESTRO guideline for elective breast radiotherapy with the humeral head as PRV

**Purpose or Objective:**
The new ESTRO consensus guideline for target delineation for elective breast radiotherapy (Offersen Radiother Oncol. 2015) establish the humeral head and connective tissues 10 mm around it as Planning Risk Volume (PRV). The objective was to implement these guidelines for sparing the humeral head in elective breast radiotherapy with level 1 and 2 (L1/L2) lymph nodes by comparing three different planning techniques.

**Material and Methods:**
Ten patients with left-sided breast cancer were enrolled in a planning study performed in Pinnacle3 v9.8 (Philips). All patients were planned with 16 x 2.66Gy on the breast (PTVb) and the elective L1/L2 lymph nodes (PTVn). We compared three techniques: IMRT with high tangential field (HTF), 6-field IMRT and VMAT. The humeral head PRV (hh+10) was included with an objective of V40Gy < 1cc for all three techniques. Treatment plans were obtained with the inverse planning tool and optimization was achieved by decreasing the dose to the organs at risk (OARs; lungs, heart and right breast) as low as possible while maintaining a PTVp V95% of 97% and PTVn V90% of 95%.

For the high tangential fields, the cranial border of the fields was extended to include PTVn. The leaves of the 5 mm multi leaf collimator were then closed to exclude hh+10 to reduce the dose to the humeral head and the surrounding tissue. This technique is currently used in our clinic. The 6-field IMRT technique consisted of tangential fields and four additional fields (at 330, 20, 80 and 170 degrees) to ensure proper coverage of the cranial part of the breast and the lymph nodes. The cranial border of the tangential fields and caudal border of the four additional fields was set 1 cm below the attachment of the clavicle at the sternum. The third technique was a VMAT dualarc from 305 to 180 degrees.

**Results:**
HTF resulted in an average PTVp V95% of 97.2% and an average PTVn V90% of 90.4% (see Table 1). With the additional fields of the 6-field IMRT technique, the coverage of the lymph nodes increased significantly to an average of 98.0% (p < 0.01) while PTVp did not vary significantly (p = 0.92). The doses to the OAR were comparable between the HTF and IMRT technique. The coverage of PTVn increased when using VMAT to an average of 99.5% (p < 0.01 compared to HTF and p = 0.19 compared to IMRT). The dose to the OAR increased as well. The mean dose to the contralateral breast increased significantly from 0.66Gy with HTF and IMRT to 2.3Gy with VMAT (p < 0.01 for both).

**Table 1:** Dosimetric parameters for the planning target volumes (PTVp and PTVn), planning risk volume (humeral head + 10 mm) and the organs at risk for high tangential fields (HTF), 6-field IMRT and VMAT.

<table>
<thead>
<tr>
<th></th>
<th>HTF</th>
<th>IMRT</th>
<th>VMAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTVp V95% (%)</td>
<td>97.2 (91.3 - 99.5)</td>
<td>97.1 (96.6 - 97.3)</td>
<td>97.8 (96.6 - 97.4)</td>
</tr>
<tr>
<td>PTVn V90% (%)</td>
<td>90.4 (87.1 - 98.5)</td>
<td>90.3 (85.9 - 99.9)</td>
<td>90.5 (95.2 - 99.9)</td>
</tr>
<tr>
<td>hh+10 V40Gy (%)</td>
<td>0.46 (0.1 - 1.02)</td>
<td>0.67 (0.1 - 1.08)</td>
<td>0.70 (0.1 - 1.35)</td>
</tr>
<tr>
<td>Lungs Dmax (Gy)</td>
<td>4.7 (2.0 - 6.1)</td>
<td>4.8 (3.8 - 5.9)</td>
<td>5.2 (4.2 - 6.8)</td>
</tr>
<tr>
<td>Breast Dmean (Gy)</td>
<td>2.3 (1.6 - 6.1)</td>
<td>2.9 (1.6 - 5.7)</td>
<td>3.6 (2.0 - 5.7)</td>
</tr>
<tr>
<td>Right Breast Dmean (Gy)</td>
<td>0.6 (0.3 - 0.9)</td>
<td>0.6 (0.3 - 0.7)</td>
<td>2.3 (0.6 - 4.2)</td>
</tr>
</tbody>
</table>

**Conclusion:**
The humeral head and surrounding tissues as defined in the new ESTRO guideline can be spared with the 6-field IMRT or VMAT technique. It is not possible through high tangential fields without reducing PTVP coverage.

A 6-field IMRT technique including tangential fields and four additional fields to cover the lymph nodes and the cranial part of the breast leads to adequate coverage of the primary target and the lymph nodes without increasing the dose to the other OARs.

**PO-0848**
Simultaneous integrated protection (SIP): a new concept for high precision radiation therapy

**Purpose or Objective:**
Stereotactic radiotherapy near critical serial organs at risk (OAR) requires specific caution to avoid severe toxicity. Current strategies are to (1) to rule out SBRT as a treatment option, (2) to use full dose SBRT and expose patients to higher risks, (3) to homogenously underdose the entire planning target volume (PTV), or (4) to trim PTV margins individually and non-quantifiably. We here describe a novel IMRT prescription method termed simultaneous integrated protection (SIP) for quantifiable and comparable dose prescription to targets very close to dose limiting structures. This work will be focussed on the planning of SBRT.

**Material and Methods:**
For patients with infringement of dose constraints to at least one serial OAR, e.g. central airways, bowel, we defined a planning risk volume (PRV). The intersection volume of the PRV with the total planning target volume (PTV) was defined as the protection PTV_SIP and the vast non-intersecting majority of PTV_SIP as the dominant PTV (PTV_dom). Radiotherapy treatment planning was performed using IMRT. Dose was prescribed to PTV Dom according to ICRU in 3, 5, 8 or 12 fractions. If in doubt, preference to a higher number of fractions was given as a function of the size of PTV_SIP. D_max was allowed to be up to 130% of the prescribed dose. No specific dose was prescribed to the PTV_SIP but dose was required to stay just within the constraints for the respective OAR. Dose-volume-histogram (DVH) analysis was based on absolute volumes of OARs, not on PRVs.

**Results:**
This method led to a fall off region within PTV_SIP between the PTV_dom and the OAR. We here demonstrate this approach for six patients. Two had lesions in the chest, one in the liver, two in the pancreas and one in the left kidney (Figure 1). Size of the PTVs (PTV_SIP) ranged from 14.5 to 84.9 mL (median 49.2 mL, mean 49.7 mL; Figure 2). Sizes of PTV protection subvolumes (PTV_SIP) ranged from 1.8 - 3.9 mL (median and mean 2.8 mL). Relative PTV_SIP ranged from 2.9% - 13.4% of the size of PTV_SIP (median 7.4%). Noteworthy, the largest ratio, 13.4%, was an absolute volume of 2 mL, only. D_min of the PTV_SIP was significantly lower in patients.