lenses, as shown also in the Table. Dose values are smaller (Dmax 16.7%, i.e. around 6 Gy) than those reported in other studies. In our case, the opposed-lateral setup is associated to larger lens doses (56.6%) than those reported using the same technique in another study (26.4%), suggesting that our specific case was a difficult one, presumably age-related.

Dose to the lens (% of prescription dose)

<table>
<thead>
<tr>
<th>Delivery mode</th>
<th>Beam arrangement</th>
<th>Dmax (cGy)</th>
<th>D98% (cGy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First pediatric patient</td>
<td>Active</td>
<td>Lens sparing</td>
<td>16.7%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>posterior-obl discrete</td>
<td>49.4%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>opposed-lateral</td>
<td>56.6%</td>
</tr>
<tr>
<td>Published studies</td>
<td>Passive</td>
<td>posterior-obl discrete</td>
<td>68.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>posterior-obl discrete</td>
<td>60.6%</td>
</tr>
<tr>
<td></td>
<td>Active</td>
<td>opposed-lateral</td>
<td>26.4%</td>
</tr>
</tbody>
</table>

* Gelber et al., Radiat Oncol 2013:8:33 (18 patients).
** Cochrane et al., Int J Radiat Oncol Biol Phys 2008:70:1336-42 (39 patients).

Conclusion: The beam arrangement we applied allowed both an optimal coverage of the cribiform plate and lens sparing. The low maximal dose to the lenses might reduce the risk of radiation-associated cataract.

**EP-1692**

Dosimetric analysis of testicular doses in prostate radiotherapy at different energy levels

C. Onal1, G. Arslan1, Y. Dolek1, E. Efe2

1Baskent Universitesi Tip Fakultesi, Adana Hastanes, Department of Radiation Oncology, Adana, Turkey

Purpose or Objective: To evaluate the incidental testicular during prostate radiotherapy with intensity-modulated radiotherapy (IMRT) and volumetric-modulated arc radiotherapy (VMAT) at different energies.

Material and Methods: Dosimetric data of 15 intermediate-risk prostate cancer patients treated with radiotherapy was analyzed. The prescribed dose was 78 Gy in 39 fractions. Dosimetric analysis compared testicular doses generated by 7-field IMRT and VMAT with a single arc at 6, 10, and 15MV energy levels. Doses from the treatment planning system were verified with metal-oxide-semiconductor field-effect transistor detectors. Detectors were placed within a solid, flat phantom at 10 cm depth, from the center of the irradiated field out to 30 cm, with 2 cm distances and 1 cm depth for scattered doses. Values measured from the treatment planning system were compared with values from the detectors.

Results: The mean distance between center of the prostate and the testes was 13.5±1.4 cm (range, 11.6-16.8 cm). For a complete course of 39 fractions, mean testicular doses from the IMRT and VMAT measured in the treatment planning system were 16.3±10.3 cGy vs. 21.5±11.2 cGy (p=0.03) at 6 MV, 13.4±10.4 cGy vs. 17.8±10.7 cGy (p=0.04) at 10 MV, and 10.6±8.5 cGy vs. 14.5±8.6 cGy (p=0.03) at 15 MV, respectively. Mean scattered testicular doses in the phantom measurements were 99.5±17.2 cGy, 118.7±16.4 cGy, and 193.9±14.5 cGy at 6, 10, and 15 MV, respectively, in the IMRT plans. In the VMAT plans, corresponding scattered doses were 90.4±16.3 cGy, 103.6±16.4 cGy, and 139.3±14.6 cGy at 6, 10, and 15 MV, respectively. The scattered testicular doses were significantly higher in the IMRT versus the VMAT plans.

Conclusion: Testicular doses during radiotherapy were high enough potentially to impair the endocrine function of Leydig cells. Higher photon energy and IMRT plans resulted in higher incidental testicular doses compared to lower photon energy and VMAT plans.

**EP-1693**

Constant dose rate VMAT and step-and-shoot IMRT in head and neck cancer: a comparative plan analysis

A. Didona1, C. Zucchetti2, A.C. Dipilato1, M. Iacco3, M.B. Fanizza1, A. Frattegiani1, V. Bini1, C. Aristei3, R. Tarducci4

1Ospedale Santa Maria della Misericordia, S.C. Fisica Sanitaria, Perugia, Italy
2Santa Maria della Misericordia Hospital, Medical Physics, Perugia, Italy
3Santa Maria della Misericordia Hospital, Radiation Oncology, Perugia, Italy
4Perugia University, Internal Medicine, Perugia, Italy

Purpose or Objective: Constant dose rate VMAT (CDR-VMAT) introduces rotational arc radiotherapy for linacs incapable of dose rate variation. The goal of this study was to evaluate CDR-VMAT adequacy for the treatment of head and neck (H&N) cancer compared to Step-and-Shoot IMRT.

Material and Methods: Ten patients (five with oropharyngeal cancer -OPC- and five with hypopharyngeal cancer -HPC-) were enrolled in this study. For each patient, were defined three PTVs: PTV66Gy, PTV60Gy and PTV54Gy with a dose prescription of 66 Gy, 60 Gy and 54 Gy all delivered in 30 fractions. OARs included mandible, spinal cord, brain stem, parotids, salivary glands, esophagus, larynx and thyroid. All patients were previously treated using step and shoot IMRT with seven 6 MV coplanar beams. A protocol for CDR-VMAT plans which consisted of two arcs was established: first arc with start angle was of 182° and a stop angle of 178° in a clockwise direction; the second one in a counterclockwise direction from 178° to 182°; the final arc spacing was set to 4 degree and collimator angle to 45°. For each patient, a CDR-VMAT plan was generated according to this protocol. A dose rate of 300 MU/minute was selected for both IMRT and CDR-VMAT plans. All plans were performed with Pinnacle3 treatment planning system (v 9.8) with identical dose constraints to OARs and dose prescription to targets; it was required that PTVs D95% be 95% of prescribed dose and OARs be spared as more as possible. Dose distributions were compared by evaluating PTVs' Dmean, D2%, D50%, D98% and Homogeneity Index (HI) defined as

\[
HI = \frac{D_{2\%} - D_{98\%}}{D_{50\%}}
\]

\[= \frac{D_{2\%} - D_{98\%}}{D_{50\%}}
\]
Differences were analysed using the paired samples Wilcoxon test (significance level 0.05). Although differences were not always statistically significant, on the one hand CDR-VMAT improved HI and decreased D2% for PTVs, on the other hand it showed a reduction in the volume of the OARs receiving medium and high doses and medium doses to larynx, thyroid, parotid and salivary glands. In respect of some organs, such as the esophagus, a larger number of patients enrolled in the study would likely have resulted in statistically significant differences. Compared with IMRT, CDR-VMAT reduced delivery times although MUs were higher.

Conclusion: Our study showed that CDR-VMAT offers an additional option of rotational arc radiotherapy for linacs without variable dose rate with a lower cost.

EP-1694
Angle-restricted tomotherapy to reduce the risk of heart for left-sided breast cancer patients
H.P. Yeh1, C.H. Hsieh2,3, H.J. Tien1, C.H. Chang1, C.T. Lin1, P.W. Shueng1
1Far Eastern Memorial Hospital, Division of Radiation Oncology-Department of Radiology, New Taipei City, Taiwan
2National Yang-Ming University, School of Medicine-Institute of Traditional Medicine, Taipei, Taiwan

Purpose or Objective: The aim of this study was to evaluate the feasibility of complete-directional-complete block (CDCB) technique and to find the optimal restricted angle of helical tomotherapy (HT) in planning of locoregional irradiation including the internal mammary chain (IMC) in left-sided breast cancer.

For spinal cord, brain stem and the mandible the analysis showed significant differences statistically but they were

Material and Methods: Treatment plans were generated for 6 left-sided breast cancer patients with a planning target volume (PTV) included the breast/chest wall, supraclavicular, axillary nodes and IMC. In HT plans, complete block (CB) and CDCB were designated to spare the contralateral tissues: (1) CB was a rectangular structure with the ends connected to 10-cm away from the margin of the PTV (2) the directional-blocking area of CDCB was determined by the intersection of CB and the beam aperture passed through the 0.5 cm margin of IMC. To find the optimal CDCB, the angle of 0, 10, 15 and 20 degree of the beam according to the geometric center of IMC were used. A prescribed dose of 50 Gy in 25 fractions was planned for HT plans using CB, CDCB 0, 10,15,20 and conventional 5-field intensity-modulated radiotherapy (cIMRT). The dose coverage, homogeneity index (HI), conformity index (CI) of the target, and the dose volumes of critical structures were compared.

Results: The coverage, HI and CI of PTV in HT-CDCB 0,10,15,20 were better than those in cIMRT but did not differ from HT-CB. The mean V20 of the ipsilateral lung for HT-CDCB 15 (22.2±3.1%, p=0.029) and HT-CDCB 20 (22.1±3.5%, p=0.045) were significant reduced compared to cIMRT (27.9±4.3%). With the increasing angle of CDCB, the cardiac V30 Gy for HT-CDCB was gradually decreased and significantly lower than for cIMRT and HT-CB. Compared with cIMRT (24.3 Gy±6.9 Gy), the mean dose of left anterior descending coronary artery was effectively reduced 38.6%, 43.3%, 45.8% and 48.1% in CDCB 0, 10, 15, 20, respectively. There was no significant difference in contralateral breast for all plans. However, the mean dose of contralateral lung in HT-CDCB 20 was 6.1% higher than cIMRT (1.7 versus 1.6 Gy) and 14.5% than HT-CDCB 15.

Conclusion: CDCB technique is feasible for locoregional irradiation including the IMC in left-sided breast cancer patients treated with helical tomotherapy. Considering the mean dose of the contralateral lung, the optimal angle for CDCB could be 15-degree that not only achieved similar PTV coverage, homogeneity and dose conformity but also allowed sparing heart and bilateral lungs compared with cIMRT.

EP-1695
Dosimetric comparison of Helical Tomotherapy and VMAT for endometrial cancer
A. Dizmen1, O. Yazıcı1, A.M. Kocer1, N. Kaplan1, F. Ertan1
1Ankara Oncology Hospital, Radiation Oncology, Ankara, Turkey

Purpose or Objective: The purpose of the present study was to evaluate dosimetric comparison of volumetric modulated arc therapy (VMAT) and helical tomotherapy (HT) for patients with endometrial cancer.

Material and Methods: Fourteen patients with endometrial cancer were retrospectively studied. All whole pelvis(WP) patients were treated with 50.4 Gy in 28 fractions. The dose distributions for the planning target volume (PTV), organs at risk(OARs), monitor unit(MU) and homogeneity index(HI= D100-D50)/Dmedian were analyzed.

Results: The V93 and D100 of PTV were 99.8%, .99.4% and 46.3 Gy, 48.2 Gy for the VMAT and HT, respectively (p<0.004, p<0.001). The V20 for the bowel was 44.5 Gy and 51.1 Gy for the VMAT and HT and the value was given by 645 and 52.36 MU(p=0.001) and the average homogeneity index was 0.07 and 0.04 (p=0.002), respectively.

Conclusion: Both HT and VMAT plans yielded with homogeneous dose distribution when sparing of OARs effectively. Although some dosimetric parameters have shown significant differences statistically but they were