Material and Methods: 25 Patients were included, with regional nodes level I-IV. Twelve were left-sided with breath-hold treatments. All were planned with both original 3DCRT and a new hybrid 3DCRT-IMRT techniques. Delineations were made according to ESTRO guidelines. Comparison was based on DVH parameters for OARs, namely lung, heart, oesophagus, contra-breast (eg V20, Dmean) and the PTV (V95%, D2%, D98%, conformity). Analysis was performed using SPSS. Further analysis focussed on the efficacy for breath-hold treatments and efficiency in planning and delivery.

Results: The hybrid plan required extra structures to help avoid hotspots, which is especially important for heart-sparing breath-hold treatments. In general, hybrid plans were superior to 3DCRT plans. An exception was the slightly higher, but acceptable, average dose to selected OAR. Resulting clinical recommendations are as follows: for level I/II, where the delineation of lymph nodes in the cranial direction are limited to lateral side, an optimal plan may be created from 2-3 3DCRT open fields and 2-4 IMRT fields. For level I-IV (also with parasternal lymph node involvement), plan as for level I/II above, with an abutment involving no more than 2 fields. Previously 3DCRT treatments required 10-12 fields, hybrid plans require at most 7 fields (each 3 segments) and only half of the MUs.

Conclusion: Hybrid 3DCRT-IMRT plans are a major improvement on the current 3DCRT technique, with fewer hotspots and more control over the dose to OARs and the target. Planning objectives were achieved, with fewer fields, MUs and field abutments, without the need for wedges. In addition, the treatment length has been reduced, making this hybrid technique more suitable for breath-hold delivery.

PO-1007

Optimizing the overlap sector for patients undergoing cranio-spinal irradiation by VMAT

M. Willemsen - Bosman[1], G.O.R. Janssens[1], E. Seravalli[1]
[1]*UMC Utrecht, Radiation Oncology Department, Utrecht, The Netherlands*

Purpose or Objective: Volumetric modulated arc therapy (VMAT) techniques for cranio-spinal irradiation (CSI) allows radiation delivery without any field junction. Junctions are replaced by sectors in which arcs of two consecutive isocenters overlap. The dose contribution from each arc in this sector is automatically accounted for by the treatment plan optimization process. Inaccurate patient positioning during treatment in this area of overlap between arcs belonging to different isocenters, causes regions of over- or underdosages.
The purpose of this analysis is to find an optimal length of overlap between the overlapping arcs,to minimize the dose deviations that can be attributed to patient setup inaccuracies.

Material and Methods: Five (n = 5) patients undergoing CSI were planned using the Monaco 5.1 (Elekta Ltd,Crawly, UK) treatment planning system. Each plan consisted of 2 isocenters, with an overlap sector at the mid-cervical level. For the head a full clockwise-counterclockwise (cw-ccw) arc was used, while for the spine two cw-ccw partial arcs (180-260 ° and 100-181 °).
In order to assess the optimal overlap length, plans were generated for overlap sectors of 4, 6, 8 and 10 cm. Afterwards, plans were recalculated without re-optimization for a superior isocenter shift of +0.5 cm in cranio-caudal direction and a -0.5 cm in the left-right direction ,mimicking a potential patient setup error. Dose distributions of the generated plans with isocenter shift were compared to the original plans based on V90%, V95% ,V110% of the Planning Target Volume (PTV) and Conformity Index (CI).

Results: The introduction of a shift in the superior isocenter causes a 3% decrease in the V90% of PTV independently of the overlap length (Table1).

Table 1

Average (n=5) relative differences (Δ) of V90%, V95%, V110% and CI of the PTV between the shifted isocenter and the original plans.

Overlap length (cm)	ΔV90 (%)	ΔV95 (%)	ΔV110 (%)	ΔCI (%)
4	-3	-11	-50	-31
6	-3	-10	+39	-25
8	-3	-10	+58	-31
10	-3	-14	+373	-39

A decrease in PTV coverage (V95%) is also observed and the effect is larger for the 10 cm overlap length. The volume receiving ≥110% of the prescribed dose increases when the length of the overlap becomes larger than 4 cm. The relative difference of the CI between the shifted and original plan is the smallest for the 6 cm overlap length. The smallest relative dosimetric deviations from the original non shifted plan are obtained for 6 cm overlap length.

Conclusion: To reduce the impact of setup errors during CSI by VMAT, the optimal length of the overlap sector using the Monaco 5.1 treatment planning system, should be around 6 cm.

PO-1008

In silico implementation of MRI-60Co RT. A dosimetrical comparison in cervical cancer (SIMBAD-02)

N. Dinapoli[1], L. Boldrini[1], E. Placidi[2], L. Azario[2], G.C. Mattiucci[1], D. Piccari[1], S. Teodoli[2], M.A. Gambacorta[1], S. Chiesa[1], A. Piermattei[2], V. Valentini[1]
[1]*Università Cattolica del Sacro Cuore -Policlinico A. Gemelli, Radiation Oncology, Rome, Italy*
[2]*Università Cattolica del Sacro Cuore -Policlinico A. Gemelli, Medical Physics, Rome, Italy*

Purpose or Objective: The ViewRay MRI-60Co hybrid system (MRIdian) allows MRI based targeting, structure autosegmentation and direct planning for numerous anatomical districts. Our department is implementing this technology and, up to date, we are testing QA planning procedures compared to our clinical standards in order to define which districts could take advantage from the use of the MRI-60Co technology. Aim of this investigation was to assess the impact of the implementation of the ViewRay magnetic resonance imaging (MRI)-guided 60Co radiation therapy system through an in silico planning analysis for cervical cancer treatments.

Material and Methods: Patients affected by cervical cancer (cT3; cN0, cN+) were manually segmented on Eclipse TPS v11. RapidArc (6-15 MV arcs) and 5 beams (6-15 MV) sliding window IMRT treatment plans were calculated according to our usual QA protocols by skilled planners. The PTV1 (CTV1+7/10 mm margin) was represented by the tumor, the PTV2 (CTV2+7 mm margin) by drainage pelvic nodes. The OaRs considered for this analysis were the body, the bowel bag and the bladder. The total prescribed dose for PTV2 was 39.6/1.8 Gy and 50.6/2.3 Gy for PTV1 through simultaneous integrated boost. The PTV V95 and OaRs QUANTEC dose constraints on the DVHs and Wu's homogeneity indexes (HI) were then analyzed to ensure the dosimetrical reliability of the plans. The structure sets were then uploaded on the MRIdian workstation and a 60Co plan was calculated by beginner planners after a specific training session. The DHVs and HI were then compared to the RapidArc and IMRT gold standard in order to evaluate MRIdian's performances.

Results: We calculated ten sets of three plans (MRI-60Co, RapidArc and 5 beams static IMRT) for ten consecutive patients. The MRI-60Co system showed a better HI when compared to the other techniques for PTV1, while this advantage could not be appreciated for PTV2, even if a better PTV2 V100 (39.6 Gy) was observed. Comparable mean doses for the bladder were registered, while a higher bowel V45 was observed (even if still in the constraints limits). Low dose body V5 was higher for the MRI-60Co system. The results are summarized in table 1.

Mean	MRIdian	RapidArc	IMRT
V95 PTV1 [%]	98.9	95.7	96.0
V105 PTV1 [%]	0.1	0.0	0.1
V95 PTV2 [%]	98.4	98.0	95.4
V100 PTV2 [%]	70.4	52.2	56.1
V105 PTV2 [%]	21.6	10.3	8.8
V5 Body [cc]	14615	12883	12617
V20 Body [cc]	7003	5004	6086
V45 Bowel Bag [cc]	9.5	6.3	6.9
Mean Dose Bladder [Gy]	37.2	36.2	37.0
Homogeneity Index PTV1	1.5	1.9	2.1
Homogeneity Index PTV2	7.8	5.5	6.0

Standard Deviation	MRIdian	RapidArc	IMRT
V95 PTV1 [%]	0.4	1.8	1.3
V105 PTV1 [%]	0.1	0.1	0.3
V95 PTV2 [%]	0.5	1.1	2.0
V100 PTV2 [%]	1.5	11.4	8.4
V105 PTV2 [%]	3.5	6.5	3.6
V5 Body [cc]	3837	3537	3598
V20 Body [cc]	1857	1620	1235
V45 Bowel Bag [cc]	18.1	13.1	14.1
Mean Dose Bladder [Gy]	3.7	1.9	2.5
Homogeneity Index PTV1	0.2	0.7	0.6
Homogeneity Index PTV2	0.4	1.4	1.0

Conclusion: We registered an higher PTV dose coverage between MRIdian's and the RapidArc and IMRT plans for cervical cancer, with a HI advantage for the PTV1. Differences were described for OaRs, especially for low dose areas (V5 Body). The MRIdian's planning platform showed to be user friendly and allowed to reach dosimetrical goals comparable to RapidArc and IMRT gold standards. The evaluation of a possible reduction in PTV margins and a proper target coverage by MRI based gating will be analyzed when the system will become operative.

PO-1009

VMAT planning approach to avoid superficial underdosage for accelerated partial breast irradiation

F. Zucconi[1], P. Mancosu[1], G. Reggiori[1], F. Lobefalo[1], A. Stravato[1], A. Gaudino[1], V. Palumbo[1], L. Paganini[1], F. De Rose[2], S. Tomatis[1], M. Scorsetti[2]

[1]*Humanitas Clinical and Research Center- Rozzano- Milan-Italy, Medical Physics Unit of radiation therapy, Rozzano, Italy*

[2]*Humanitas Clinical and Research Center- Rozzano- Milan-Italy, Departement of Radiotherapy and Radiosurgery, Rozzano, Italy*

Purpose or Objective: Accelerated Partial Breast Irradiation (APBI) is a RT approach that treats only the lumpectomy bed plus a margin, rather than the whole breast. The dose fluence outside the breast contour to account for breathing and residual motions can be manually increased with RapidArc/VMAT. At this aim, a 10 mm virtual expansion of the breast with soft-tissue equivalent HU is usually applied to the CT series (CT_E) and the optimization is performed on the APBI target expanded along the anterior/lateral directions. However, the dose recalculated on the original CT series (CT_O) could underdose the superficial target volume. In this study, a simple technical strategy to increase the target superficial dose is presented.

Material and Methods: Ten patients treated by APBI were randomly selected from the internal database (41 patients since 06/14). PTV_O was defined on CT_O as the tumor bed + 1-2cm, cropping it of 5 mm to the body. Dose prescription was 30 Gy in 5 fractions. Plans were normalized to PTV_O mean dose. PTV_E was defined on CT_E, expanding PTV_O of 10 mm in anterior/lateral directions. PTV_E was subdivided in three parts: PTV_EI (PTV_E cropped of 7 mm from the CT_O body - internal), PTV_ES (PTV_E cropped 5-7 mm - superficial), PTV_EE (PTV_E minus PTV_EI and PTV_ES - external). Two plans were optimized on the CT_E: (i) prescribing the same dose to the three PTVs, (ii) PTV_EI = 30 Gy, PTV_ES = 32 Gy, PTV_EE = 33 Gy. Final dose calculations for the two optimizations were performed on the CT_O. Plan objectives were: D98% (dose received by 98% of the target volume) > 95% and D2% < 107% for PTV, minimizing the homogeneity index (HI=D2%-D98%); V15Gy (volume of the organ receiving 15Gy) < 50% for breast minus PTV; V10Gy < 20% for ipsilateral lung; V5Gy < 10% for controlateral lung; V3-5Gy < 10% for heart, Dmax < 1-2 Gy for controlateral breast. Plans were compared in terms of dosimetric plan objectives findings.

Results: Figure 1 shows the different dose distribution for the two optimizations on the CT_O and CT_E. Opposite dose distributions outputs were obtained on the two CT series. On the CT_E, D98%, D2%, and HI were favorable to the (i) (respectively, 94.9% vs 94.5%, 103.7% vs 105.9%, 8.8% vs 11.5%). On the CT_O, D98%, D2%, and HI were favorable to the (ii) (respectively, 92.3% vs 94.2%, 104.3% vs 104.2%, 12.1% vs 10.1%). In particular, the superficial volume (i.e. PTV_ES) was the region of highest underdosage (D98%= 85.4 ± 3.3% for the first approach). Regarding the OAR, minimal changes were found between the two approaches.

Conclusion: A virtual overdosage on the superficial part of the APBI target is required to account for involuntary motions. A simple procedure was showed to fully cover the target.

Poster: RTT track: Head and neck reduction of margins and side effect

PO-1010

Partial delegation in 2-D match set-up evaluation for H&N IGRT treatment: preliminary results

A.R. Alitto[1], A. Pesce[1], S. Menna[1], M. Massaccesi[1], S. Manfrida[1], A. Pacchiarotti[1], A. Castelluccia[1], F. Miccichè[1], N. Dinapoli[1], G.C. Mattiucci[1], R. Autorino[1], F. Catucci[1], L. Azario[1], S. Luzi[1], V. Valentini[1], M. Balducci[1]

[1]*Università Cattolica S Cuore, Radiation Oncology Department- Gemelli-ART, Rome, Italy*

Purpose or Objective: Aim of this study was to determine the magnitude of discrepancies between radiation oncologists and radiation therapists to define a partial delegation of verification when 2-D orthogonal Kilovoltage (Kv) images are evaluated for daily set-up verification in head and neck cancer patients.

Material and Methods: Daily on-line kV-images of patients with head and neck cancer were evaluated for set-up verification both on-line by one of 7 radiation therapists (RTT) with adequate training, and off-line by a radiation oncologist (RO). All patients were treated by volumetric-modulated arc therapy (VMAT), by a LINAC 6 MV photon beam equipped with Millenium 120 MLC and on-board imaging system (VARIAN Medical System). Manual bone anatomy matching was used to determine translational displacements in all three axes (x, y, z) and discrepancies between RTT and RO were calculated. The concordance of decisions between RTT and RO were calculated, in particular for differences inferior, equal and superior to 3 mm. Results are presented as mean values, population systematic (Σ) and random (σ) errors. ANOVA test was used to test differences between groups. SPSS software was used for the statistical analysis.

Results: In this analysis 33 consecutive patients treated from March to September 2015 were included. Nine hundred ten (910) kV images were obtained and 2730 measures were made by the RO and RTT. A total agreement between RO and RTT was observed in 12.2% of cases. An inter-observer discrepancy of ±3mm or less and ±4 mm or less on at least one direction was recorded respectively in 98.4% and 99.3%