PO-1004
Optimising breast dosimetry: improving homogeneity through the application of angled IMRT fields
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Purpose or Objective: Studies have demonstrated significant side effects associated with dose inhomogeneity and low dose integral splay. Several techniques seek to maximise dose uniformity whilst minimising regions of low dose. The angled segment technique offers two additional options, each allowing for control over homogeneity (HI) and low dose conformity (CI).

Material and Methods: Tangent fields of twenty previously optimised plans were copied. Two re-optimisation methods were applied. Firstly, a single medially angled off inversely planned (I-IMRT) beam was appended to the existing beamset. The plans were further optimised and normalised (PTV V47.5 = 99.00%). Secondly, an additional acutely laterally angled off I-IMRT beam was added, reoptimised, and normalised.

Results: The addition of the single I-IMRT beam resulted in a statistically similar average absolute maximum dose (Dmax 54.55Gy vs. 54.71Gy, p=0.33) but a markedly reduced V100% (14.71cc vs. 23.17cc, p<0.01). Low dose (V1) integral splay was maintained (6410.04cc vs. 6402.45cc, p=0.44), but was reduced marginally contralaterally (V1 splay over midline 6.60cm vs. 6.80cm, p=0.04). Dose to the ipsilateral lung was reduced marginally contralaterally (5.23Gy vs. 5.33Gy, p=0.04). The additional 6.60cm vs. 6.80cm, p=0.04). Dose to the ipsilateral lung was reduced marginally contralaterally (5.23Gy vs. 5.33Gy, p=0.04). The additional 6.60cm vs. 6.80cm, p=0.04). Dose to the ipsilateral lung was reduced marginally contralaterally (5.23Gy vs. 5.33Gy, p=0.04). The additional V107% size was substantially increased (1.90cc vs. 23.17cc, p<0.01). Homogeneity was improved (HI= 0.11 vs. 0.13, p=0.03), whilst the ipsilateral mean lung dose was unaffected (5.33Gy vs. 5.33Gy, p=0.48). The volume of the low dose (V1) integral splay increased by an average of 1.5% (6501.14cc vs. 6402.45cc, p=0.04), and appeared further contralaterally (8.40cm vs. 8.60cm over midline, p=0.02).

Conclusion: The application of additional acutely angled fields provides scope to reduce regions of high dose and improve breast homogeneity while controlling integral dose splay.

PO-1005
Dosimetric effect of US versus CT delineation on postplanning I-125 treatment
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Purpose or Objective: Since 2000 we have been treating low- and intermediate-risk prostate cancer patients with permanent Iodine-125 implants. After 6 weeks postimplant dosimetry (PID) was performed using the Pro-Qura technique (Allen et al, 2008). In a previously performed study in our institute (cohort of 394 patients), we found that the dosimetric quantifier V100 was not correlated with biochemical relapse. Therefore, we examined the PID method to obtain more detailed information on the quality of the PID parameters. From the literature it appeared that in PID many uncertainties affect the quantifiers: delineation, source identification and imaging modalities (De Brabandere et al, 2012). In 2014 we started working with an automated seed reconstruction system (Elekta) to eliminate uncertainties in source identification. However, the other uncertainties still remained. Furthermore, the craniocaudally length of the Ultrasound (US) prostate contour was distally more extended compared to the contour on the postplan CT-scan. This could be explained by the deformation of prostate by the US probe. The main purpose of this study was to determine the differences in PID based on US- or CT-contours.

Material and Methods: For 71 patients in supine position an axial CT-scan (1 mm slice thickness) was made of the prostate. One radiation therapist (RTT) performed the PID using the US prostate contour fused with the postplan CT-scan. The apex area was defined as the volume derived from a quarter of the base-apex distance. We analyzed the V100 of the apex area and selected the patients with a coverage of less than 67%. Thereafter, we randomly selected 2 groups of patients: Group A: 5 patients with an optimal postplant implantation in the apex area conform Pro-Qura.Group B: 5 patients with an inferior implantation result in the apex area, a coverage of less than 67%. For each patient, one radiation oncologist delineated the prostate on the CT-scan, trying to ignore the seeds. With that new delineated prostate the RTT performed a PID and these CT-based results were compared to the original results. To see the difference in length of the prostate on both modalities, we defined the last slice of the visible apex on both US and CT.

Results: Between the US- and CT-scan volume an absolute difference was found of 12% (SD 2%). In both groups we found, in four out of five patients, that the apex on CT was positioned less caudally compared to the US-scan, figure. This was 4 and 10mm for group A and B respectively.

Conclusion: The volume of the prostate depends on the image modality. Consequently, the PID results differ as a function of image modality. This needs to be studied in a larger cohort of patients and could help to define on which modality the delineation and the PID needs to be performed.

PO-1006
A breath-hold friendly, hybrid 3D CRT/IMRT technique for locoregional breast irradiation
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Purpose or Objective: IMRT optimises not only the planned dose, but also the clinical preparation and treatment delivery. Until recently, our hospital used a standard 3DCRT for the breast, thoracic wall and lymph nodes ranging from level I to IV, including the parasternum. This usually leads to inconsistent OAR sparing, PTV coverage and conformity, abutting region from multiple fields and long treatment times due to many, high-MU fields. The objective of this study was to develop a hybrid 3D CRT/IMRT technique for locoregional breast irradiation, which is also “breath-hold friendly” i.e. fewer MUs and fields. This technique should optimise planning and treatment times, maintain or reduce dose to OAR, improve PTV homogeneity, avoid the use of wedges and minimise the number of abutting beams.
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 focused 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
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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, Crawley, 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 (Table 1).

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 dosimetric comparison in cervical cancer (SIMBAD-02)
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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 dosimetric 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 DVHs 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.