# Does level of DIBH amplitude correlate to reduction in cardiac dose in left breast cancer patients? (Abstract only)

LEDSOM, D, REILLY, A and PROBST, Heidi <http://orcid.org/0000-0003-0035-1946>

Therapy Oncology Group (RTOG) protocol 1306. Determination of isocentre, beam arrangement and dose constraints were kept constant in each case. All plans were computed using Varian Eclipse version 11.0 treatment planning system. The plans were then evaluated based on the target coverage, homogeneity, conformity, number of monitor units (MU) to be delivered and dose-volume constraints for various organs at risk (OARs).

**Results:** All plans exhibited comparable PTV homogeneity (HI ≤ 7.5) and conformity (CI > 96%) with a steep dose fall-off outside the PTVs but at the expense of increased MUs by 39.4% (p=0.007) and 44.7% (p=0.005) for FFF beams at 6 MV and 10 MV respectively. FFF beams offered better dose sparing of OARs than flattened beams. Spinal cord+5mm and volume of 'whole lung (WL) – Gross tumour volume (GTV)' (WL-GTV) that received 20Gy (V20) were reduced by 2% (p=0.017) and 2.8% (p=0.016) respectively in X10FFF plans when compared with X10FF plans. There was also a 16.4 % dose reduction to brachial plexus in X10FFF plans than X6FFF plans.

**Conclusion:** The application of FFF IMRT for NSCLC yielded quantitatively comparable dosimetric distribution with better sparing of the OARs including 'spinal cord+5mm', V20 of 'WL-GTV' and brachial plexus than using FF beams.

## PO-1002

### A comparison of outcomes using VMAT and 3DCRT in treatment of esophageal cancer

E. Jimenez-Jimenez[1], J. Font[2], P. Mateos[2], F. Romero[2], J. Pardo[1], N. Aymar[3], I. Ortiz[3], M. Vidal[3], S. Sabater[4]
[1]*Hospital Universitari Son Espases, Radiation Oncology Department. Research Group IDISPA, Palma de Mallorca, Spain*
[2]*Hospital Universitari Son Espases, Medical Physics Department, Palma de Mallorca, Spain*
[3]*Hospital Universitari Son Espases, Radiation Oncology Department, Palma de Mallorca, Spain*
[4]*Complejo Hospitalario Universitario de Albacete, Radiation Oncology Department, Albacete, Spain*

**Purpose or Objective:** There are few studies comparing 3-dimensional conformal radiation therapy (3DCRT) and volumetric modulated arc therapy (VMAT) in treatment of esophageal cancer. These studies often compare 3DCRT unsophisticated, with few treatment beams, which is not common in clinical practice.
Our aim was to compare a modern 3DCRT plan with VMAT using dose volume histograms (DVH) and evaluate the dosimetric profile.

**Material and Methods:** We evaluate 7 patients with esophageal cancer (4 medium, 2 distal and 1 upper neoplasms). All were contoured using PET-CT and treated with radio-chemotherapy. Target volumes for primary lesions (50-50,4 Gy) and electively treated regions (45 Gy) were contoured.
Every patient had 2 dose-plans, one with 3DCRT (8-10 beams) and other with VMAT (2 arcs) techniques. For each technique, we evaluate the coverage target, homogeneity index of PTV (HI), conformity index (CI), monitor units and DVH metrics of lungs, heart and spinal cord.

**Results:** VMAT plans reduced total lung volume treated above 20 Gy (V20) and mean lung dose (MLD), but volume treated above 5 Gy (V5) were higher than 3DCRT. VMAT improved total heart volume treated above 20 Gy and 40 Gy (V20, V40) and maximum dose to cord.
Monitor units (MU) were higher with the 3DCRT. HI and CI are better with VMAT technique. Coverage target was very high with both schemes. Statistically meaningful differences were observed (Table 1).

**Conclusion:** Our results suggest that VMAT for radical treatment of esophageal cancer is useful for decreasing dose in organs at risk. It can play a more important role in some locations, such as cervical cancer. Nevertheless, VMAT increases low-doses in lung and this may contribute increase pulmonary complications.
A complex multibeam technique -3DCRT preserves constraint of organs at risk with high conformity and homogeneity of the target.

| | | 3DCRT | VMAT | p-value |
|---|---|---|---|---|
| Target | Coverage (%) | 98,1 ± 1,4 | 95,4 ± 1,1 | < 0,05 |
| | HI | 0,083 ± 0,016 | 0,047 ± 0,006 | < 0,05 |
| | CI | 1,62 ± 0,15 | 1,00 ± 0,03 | < 0,05 |
| Lung | V5 (%) | 80,5 ± 11,0 | 83,9 ± 12,0 | < 0,05 |
| | V20 (%) | 24,5 ± 4,9 | 14,5 ± 10,0 | < 0,05 |
| | MLD (Gy) | 15,03 ± 2,13 | 12,78 ± 2,72 | < 0,05 |
| Heart | V20 (%) | 48,8 ± 23,2 | 28,2 ± 22,6 | < 0,05 |
| | V40 (%) | 16,4 ± 15,8 | 3,7 ± 4,1 | < 0,05 |
| Spinal cord | Maximum dose (Gy) | 40,2 ± 3,7 | 33,0 ± 4,1 | < 0,05 |
| | 1 cm$^3$ dose (Gy) | 36,3 ± 4,6 | 30,1 ± 3,6 | < 0,05 |
| Monitor units | | 588 ± 98 | 558 ± 127 | 0,499 |

## PO-1003

### Does level of DIBH amplitude correlate to reduction in cardiac dose in left breast cancer patients?

D. Ledsom[1], A. Reilly[2], H. Probst[3]
[1]*Clatterbridge Cancer Centre, Radiotherapy, Bebington, United Kingdom*
[2]*Clatterbridge Cancer Centre, Physics, Bebington, United Kingdom*
[3]*Sheffield Hallam University, Faculty of Health and Wellbeing, Sheffield, United Kingdom*

**Purpose or Objective:** The aim was to investigate whether the amplitude level achieved during DIBH impacted on the mean cardiac dose and V30 reduction in 30 women treated for a left sided breast cancer during radiotherapy.

**Material and Methods:** Patients were dual scanned in free breathing and DIBH. Varian Real-time Position Management (RPM) was used to record and monitor breathing. Plans were virtually simulated with field borders following IMPORT high guidelines. Pinnacle treatment planning software was used for dosimetric calculation; all plans conformed to ICRU 62. Spearman's Rank correlation and statistical analysis was performed using SPSS v22. All patient data was annonymised. To improve reliability and assess validity of the researcher, 10 of the 30 patients were chosen at random, re-outlined and re-planned to confirm consistency and intra-rater reliability. The heart was also re-contoured for one patient 5 times to calculate the error in heart contouring.

**Results:** All patients achieved decreased cardiac V30 and mean cardiac dose reduction using DIBH technique. Moderate positive correlation between DIBH amplitude and cardiac V30 reduction was statistically significant (p=0.007, R=0.48). Ratio increase from free breathing to DIBH and cardiac V30 reduction was also positively correlated and statistically significant (p=0.04, R=0.38). Twenty seven percent of patients achieved full cardiac V30 reduction and 73% of patients achieved over 90% reduction. Ratio of amplitude increase from free breathing to DIBH ranged from 4-27 times with ratios of at least 15 times free breathing all achieving 100% cardiac V30 reduction. However 100% cardiac V30 reduction was observed with amplitude of ratio increase as low as 6.25 times free breathing.
Positive correlation between DIBH amplitude and mean cardiac dose reduction was statistically significant (p=0.003, R=0.523). Seventy seven percent of patients achieved over 50% mean cardiac dose reduction with DIBH amplitudes of 1.04-5.46cm. Correlation of ratio of amplitude increase from free breathing to DIBH and mean cardiac dose reduction was not statistically significant (p=0.316, R=0.189).

**Conclusion:** A 100% reduction in cardiac V30 can be achieved with a DIBH amplitude increase 15 times free breathing, yet full reduction can also be achieved at much lower levels (6.25 times free breathing in the current study) suggesting patients unable to achieve a large amplitude increase may still be able to achieve 100% reduction. DIBH amplitudes of 1-5cm reduce cardiac mean dose by at least 50%.

### PO-1004
### Optimising breast dosimetry: improving homogeneity through the application of angled IMRT fields

M. Squires[1], S. Cheers[1]
[1]*Radiation Oncology Centres, Gosford, Gosford, Australia*

**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 V107% (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 slightly reduced (5.23Gy vs. 5.33Gy, p=0.04). The additional duel angled off I-IMRT fields reduced the average maximum dose (Dmax 53.79Gy vs. 54.71Gy, p=0.03) and the V107% size substantially (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. 6.80cm 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

J. Van der Klein[1], M. Mast[1], P. Koper[1], P. Rietveld[1], J. Van Wingerden[1], H. De Jager[1]
[1]*Haaglanden Medical Centre Location Westeinde Hospi, Radiotherapy Centre West, Den Haag, The Netherlands*

**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 postplan 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.

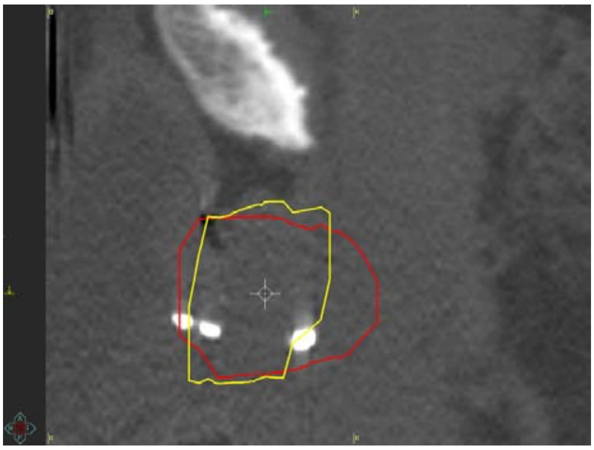

*Figure: Delineated prostate volumes. Red: US; Yellow: CT.*
For all patients, we found in both groups a significantly higher V100 using the prostate contours of the CT-scan.

**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 3DCRT/IMRT technique for locoregional breast irradiation

K. Hunnego[1], D. Martens[1], D. Steeneveld[1], A. Dijkhuizen[1], L. McDermott[1], F. Gescher[1], G. Speijer[1]
[1]*HagaZiekenhuis, Radiotherapy, The Hague, The Netherlands*

**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 3DCRT-IMRT technique for locoregional breast irradiationl, 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.