**Results**
Averaged over all three cases, the mean dose to the parallel OARs is 28% lower, D2% to the serial OARs is 28% lower and V10% to normal tissue is 14% lower for DT-MBRT plans compared to VMAT plans. For every case, the PTV dose homogeneity and coverage is similar for the DT-MBRT and the VMAT plan. The electron contribution defined as the integral dose in the PTV summed over all electron apertures is 42%, 32% and 40% for the DT-MBRT plans determined for the first and second head and neck and the brain case, respectively.
**Conclusion**
Head and neck and brain treatments could remarkably benefit from DT-MBRT because of the large freedom for couch rotations and the targets which are at least partly superficial. Moreover, using DT-MBRT is not connected to large investments as it only exploits the degrees of freedom already provided by a conventional treatment unit. This work was supported by Varian Medical Systems.

**EP-1932 Assessment of Specific versus Combined Model Library in Knowledge Based Planning for Prostate Cancer**
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**Purpose or Objective**
There may be large variations in the quality of the intensity modulated radiotherapy (IMRT) plans due to variations in experience and skills of the planners which may limit the desired critical structure sparing and target coverage. Recently, many investigations have demonstrated that the knowledge based planning (KBP) has a great potential to improve the quality and consistency of the treatment planning via KBP which utilizes a library of previously treated patient treatment plans. The main objective of this study was to assess the quality of the plans generated using a specific versus combined purpose model library for prostate cancer planning.
**Material and Methods**
Ninety-seven prostate cancer patients were included in this retrospective study. First, three different KBP libraries were created using Eclipse RapidPlan software to benchmark KBP performance against clinical prostate IMRT plans. The original model libraries consisted of patients treated to the (a) prostate alone (P_KBP, 66 patients), (b) prostate and pelvic lymph nodes (PPLN_KBP, 31 patients), and (c) a model library combining the patients in model libraries (a) and (b) (P_PPLN_KBP, 97 patients). The number of dosimetric outliers in each library was, identified and re-planned. Then, the refined P_KPB, PPLN_KBP and P_PPLN_KBP libraries which include replanned plans were created. Both original and refined three model libraries were validated on an independent set of ten patients treated to the prostate alone and ten patients treated to the prostate plus pelvic lymph nodes. All plans were normalized such that 96% of the prostate planning target volume (PTV) received 100% of the planned dose. All P_KPB, PPLN_KBP and P_PPLN_KBP based plans were compared against each other and clinical plans using the dose-volume constraints for targets and critical structures.
**Results**
For both P_KBP and PPLN_KBP validation plans, no statistically significant differences (P> 0.05) were found between plans generated by P_KBP, PPLN_KBP and P_PPLN_KBP libraries, with some critical structures being spared slightly better for one or the other model library, but no consistency as to which model library was better for any particular plan. The differences between plans generated using original versus refined libraries were also negligible. However, there were 23% and 29% reduction in Dmax for left femur and right femur respectively using both PPLN_KBP and P_PPLN_KBP libraries as compared to the manual clinical plans by an expert planner.

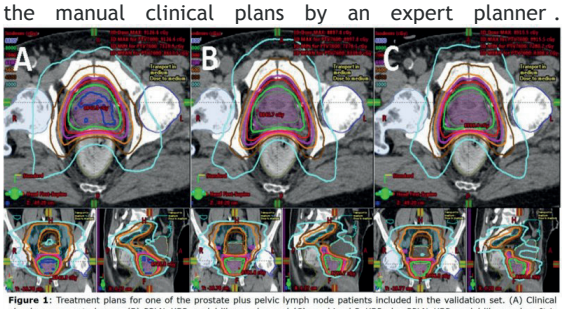

**Figure 1**: Treatment plans for one of the prostate plus pelvic lymph node patients included in the validation set. (A) Clinical plan by an expert planner, (B) PPLN_KBP model library plan and (C) combined P_KBP plus PPLN_KBP model library plan. It is clear that there is very little difference between plans created using PPLN_KBP library and P_KBP + PPLN_KBP library and the one created by the expert planner. Note that while the P_KBP validation cases were replanned using both (a) and (c) model libraries, the PPLN_KBP validation cases were replanned using both (b) and (c) model libraries (both original and refined libraries).

**Conclusion**
This study demonstrated that no significant differences were observed between specific versus combined KBP model libraries in prostate planning. This may allow for fewer plans to be needed to create a model library. Refining model libraries did not further improve plans. Further studies are needed to evaluate benefits of combined model libraries for planning of complex sites such as head and neck.

**EP-1933 Half field VMAT for MLC leakage reduction and dosimetric impact in whole pelvis radiotherapy**
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**Purpose or Objective**
Recently, intensity modulated radiotherapy (IMRT) and volumetric modulated arc therapy (VMAT) techniques have been widely applied in patients with large irradiation field, such as whole pelvis radiotherapy (WPRT). However, if the irradiation filed is large, multileaf collimator (MLC) leakage and non-blocking phenomenon are possible to be occurred by the limitation of MLC movement. We tried to minimize these problems by using half-field VMAT (HF-VMAT) planning technique.
**Material and Methods**
We compared HF-VMAT plan with full-field VMAT (FF-VMAT) and modified full-field VMAT (MFF-VMAT) plan. Ten patients, who received whole pelvis radiotherapy with inguinal field, were included in present study. Cervical, anal, and vaginal cancer patients were 4, 4, and 2, respectively. The prescribed dose was 50 Gy (25 x 2 Gy). The normal organ dosimetric parameters for small bowel, bladder, rectosigmoid and femur head were compared according to radiotherapy planning technique. Normal tissue complication probability, conformity number (CN), and homogeneity index (HI) were also evaluated. In addition, we applied a modulation index (MI) value to support the superiority of the dose distribution by evaluating the MLC movement, gantry rotation, and dose rate.
**Results**
Mean small bowel dose of HF-VMAT plan was significantly lower than FF-VMAT plan (29.6 vs 32.9, $p<0.05$), and V30 and V40 to small bowel were also significantly lower (V30: 46.4 vs 21.4, V40: 21.4 vs 28.7, $p<0.05$). Mean bladder dose of HF-VMAT plan was significantly lower than FF-VMAT and MFF-VMAT plan (33.6 vs 40.4 vs 37.2, $p<0.05$), and V30 to bladder were also significantly lower (62.6 vs 89.2 vs 86.2, $p<0.05$). There was no statistically significant differences in rectosigmoid. HF-VMAT showed

superiority compared with FF-VMAT in CN (0.90 vs 0.86, p<0.05). For each planning technique in HI, there was not statistically significant.

**Conclusion**

HF-VMAT plan showed the improved dosimetric impact of normal organ, and the homogeneity of target volume was comparable with FF-VMAT and MFF-VMAT plan. HF-VMAT plan can be more useful option than conventional FF-VMAT plan in patient with large irradiation field.

**EP-1934 Target dose inhomogeneity evaluation in breast cancer due to tissue differences**

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**Purpose or Objective**

The mammary gland consists of small lobules composed of connective tissue (about 40% of the entire breast), separated by adipose tissue (about 60%). This difference is managed by the material assignments for dose to medium calculations: the lobular fraction is associated to muscle, the fat to adipose tissue. Aim of this study is the evaluation of the dose estimation derived from this complex composition, in terms of target (breast) dose homogeneity, using Monte Carlo (Penelope) with the PRIMO interface, and the Acuros XB dose calculation algorithm implemented in the Eclipse treatment planning system.

**Material and Methods**

Five breast patients were planned with VMAT using 2 partial arcs of 6MV beam from a Varian linac. Plans were optimized in Eclipse (vers. 13.6) using the Photon Opimizer, and the final dose distribution was estimated with Acuros XB, a Boltzmann Transport Equation solver. Dicom plan, CT data and structures were exported, to be imported in PRIMO (a free software for research, non-clinical engine for Monte Carlo simulations in the radiotherapy framework) for Monte Carlo simulations, using a Varian Clinac unit and the published phase space files (4.95E+10 histories). The average uncertainty at the end of each simulation in patient anatomy was 1.04% (range 0.99-1.08%). The chemical composition and relative assignment for HU ranges were made compatible between Acuros and PRIMO (AdiMus simulations).

The doses in the lobular and fat regions of the planning target volume PTV (delineated as PTV_lob and PTV_fat, respectively) were estimated and compared with DVH analysis.

To estimate the dose difference generated by the sole difference in the tissue composition, different assignments were applied, computing other two dose distributions per patient, assigning to both PTV_lob and PTV_fat the muscle and the adipose tissue, respectively, called Mus and Adi simulations. Mean dose difference generated by the sole tissue compositions in PTV_lob with respect to the whole breast PTV was estimated as

$$Diff(PTV_{lob} - PTV) = \left(Mean(PTV_{lob}) - Mean(PTV)\right)_{AdiMus} - \left(Mean(PTV_{lob}) - Mean(PTV)\right)_{Mus}$$

$$Diff\left(PTV_{fat} - PTV\right) = \left(Mean\left(PTV_{fat}\right) - Mean(PTV)\right)_{AdiMus} - \left(Mean\left(PTV_{fat}\right) - Mean(PTV)\right)_{Adi}$$

**Results**

The analysis of the two breast stuctures as muscle and adipose tissues showed a systematic difference in the dose calculation. Dose to lobular tissue was higher relative to the entire breast, of 1.13±0.45% (PRIMO calculation), 1.07±0.12% (Acuros calculation). Dose to fat tissue was lower relative to the entire breast, of 0.23±0.24% (PRIMO calculation), 0.28±0.16% (Acuros calculation). This data showed the compatibility between Monte Carlo (Penelope) and Acuros dose estimation in different tissues.

**Conclusion**

Monte Carlo accuracy and dose to medium estimation allow to better understand the dose deposited in the different part of a target, depending on their specific tissue composition. The difference is found to be significant. However, due to the small absolute dose difference, it is impossible to transfer this improved information into possible clinical outcome.

**EP-1935 Comparison of dosimetric characteristics in SBRT for lung with cyberknife, TOMOtherapy and VMAT**

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**Purpose or Objective**

The aim of this study is to evaluate the dosimetric characteristics of cyberknife with multi leaf collimator(CK_M) and fixed collimator(CK_F), volumetric modulated arc therapy with 10MV flattening filter-free beams(VM-F), Helical Tomotherapy with dynamic-jaw(HT), and to provide optimal modality in stereotactic radiotherapy(SBRT) for lung tumor.

**Material and Methods**

Eight patients with lung tumor were selected for this study, and grouped into classes by synchrony respiratory tracking system were used for cyberknife.(2-view lung tracking : 4cases, 0-view lung tracking : 4cases) New Treatment plans were created per patient, and the prescription dose was set as 60Gy in 4 fractions. Each plan was adjusted to be equivalent to each other; planning target volume (PTV) received ≥90% and the maximum PTV dose was limited to 120% of the prescription dose. For comparative purpose, conformity index(CI), homogeneity index(HI) and organs at risk(OAR) doses, monitor unites(MUs), treatment delivery times were assessed. Additionally, the regression analysis using target volumes receiving at 50%(V30), 30%(V18) of prescription dose were conducted in order to investigate the effects of tumor size on dose gradient and distance.

**Results**

2-view lung tracking plans of CK_M and CK_F produced lower ipsilateral mean lung dose and lung volume received 30Gy(V30) , 15Gy(V15) than HT, VM-F. (CK_M V30: 28.12±12.99, CK_F V30: 38.13±39.29 vs. HT V30: 90.69±42.22, VM-F : 101.79±43.9 and V15 : 71.37±39.24, 90.46±51.15 vs. 226.22±89.43, 236.82±95.89) There were produced similar results of V30, V15 in 0-view lung tracking plans. The regression models showed that CK_M plans were significantly dose gradients for a short distance. There was no statistically significant difference between PTV doses in all plans, HT plans achieved a slightly superior homogeneity. (HI:1, p: 0.06) CK_M and CK_F plans had longer beam delivery times than others. (1267.5±326.18 vs1395±328.24)