was 6 to 7 minutes. The displacements were 3, 7 and 6 mm at the end of treatment in left, posterior and inferior direction, respectively. For each IMRT beam, the magnitude of motion was based on the corresponding time when the beam was on. For patient 3, 25 out of 29 tracking sessions showed that transient larger prostate motion occurred in anterior and superior direction simultaneously. The maximum peak amplitude was 12 mm in anterior direction. The average cycle of the transient motion was 30s. To simplify the analysis, the transient motion was described as a pulse with width t = 5 seconds and amplitude A = 8 and 3 mm in anterior and superior direction respectively. t was the half height width of the transient motion, A is the average amplitude of all the transient motions. The beam on time of each beam was 20 to 30s, the DMLC leaf sequence of each beam was segmented into 2 to 3 sub-DMLC sequences based on the time when transient motion happened. The dose matrix was calculated for each beam or sub-DMLC sequence on patient’s planning CT in the Eclipse TPS. Then the dose matrix and CTV were exported to our in-house program to simulate the motions and calculate the resultant CTV dose for these two patients.

**Results:** For the studied fractions, with the CTV-PTV margin of 5mm, although the prescription dose coverage volume (Vp) decreased by 11.1% and 17.9% for patient 2 and 3 respectively, the equivalent uniform dose (EUD) was reduced by only 1.0% and 0.8%. If the CTV-PTV margin is reduced to 2mm, then Vp decreases by 18.6% and 23.7%, EUD is reduced by 7.9% and 5.1% for patient 2 and 3 respectively.

**Conclusions:** The dosimetric influence of intrafraction prostate motion on daily DMLC IMRT treatment seems not significant with the currently used CTV-PTV margin of 5mm. Additional patients data will be collected to further investigate the influence. With small CTV-PTV margin, e.g., 2 mm, to ensure the daily treatment accuracy, stricter intrafraction correction strategy needs to be applied.

Author Disclosure: W. Fu, None; Y. Yang, None; N.J. Yue, None; R. Selvaraj, None; A. Chen, None; K. Mehta, None; D.E. Heron, None; M.S. Huq, None.

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**2911 Impact of the Width of Multileaf Collimator on Simultaneous Integrated Boost Intensity-modulated Radiotherapy for Prostate Cancer**

E. Abe¹, T. Mizowaki², Y. Norihsia², Y. Narita², Y. Matsuo³, M. Narabayashi², Y. Nagata², M. Hiraoka²

¹Division of Radiation Oncology, Department of Molecular Genetics, Course for Molecular and Cellular Medicine, Graduate School of Medical and Dental Sciences, Niigata University, Niigata, Japan. ²Department of Radiation Oncology and Image-applied Therapy, Graduate School of Medicine, Kyoto University, Kyoto, Japan

**Purpose/Objective(s):** Prostate cancer is a dose-responsive neoplasm, and simultaneous integrated boost intensity modulated radiotherapy (SIB-IMRT) has a potential to deliver high doses of radiation to dominant intraprostatic lesions (DIL) within the prostate while protection the rectum. The present study explored the impact of collimator leaf width on SIB-IMRT for prostate cancer.

**Materials/Methods:** Prostate cancer maps were produced based on histopathological findings of seven radical prostatectomy specimens for patients with clinically stage T1-2N0M0 prostate cancer. These maps were superimposed on to simulation CT images for seven patients who received definitive IMRT. Positions of the major DILs were transferred onto the CT images using a mathematical algorithm and the area of the DILs was handwritten on the CT images. The CTV1 was defined as the prostate and the base of seminal vesicles, and the CTV2 was defined as DILs. The PTV1 and PTV2 were volumes defined by adding a 5 mm margin to the CTV1 and CTV2, respectively. For each case, three SIB-IMRT plans were created using three different MLCs; m3 (BrainLAB, the minimal leaf width is 3 mm), the Millennium (Varian, the minimal leaf width is 5 mm), and the Mark II (Varian, the leaf width is 10 mm). All plans were designed to deliver 74 Gy to the PTV1 and 84 Gy to the PTV2. Inverse optimizations were performed until the following planning goals were completely satisfied. As for the PTV1 and PTV2, the percent of the prescription dose covering 95% of the volume (D95) should be 95%, and the maximum dose to the PTV2 should be identical for each width of dMLCs. With regard to the urethra, the maximum dose should be less than 82 Gy. The doses to the targets (PTV1 and PTV2), and the Conformation Number (CN) were evaluated and compared among the SIB-IMRT plans using three different MLCs based on DVH analyses.

**Results:** There are no statistical differences in the D95 of PTV1 and PTV2 among three SIB-IMRT plans using the different MLCs. Maximum doses to the PTV2 are almost identical among the three plans for each patients. In all cases, the maximum doses to the urethra were less than 82 Gy, and there are hardly differences comparing among three plans. The CN of the PTV1 for plans using the m3, the Millennium, and the Mark II were 0.68 ± 0.04, 0.67 ± 0.04 and 0.63 ± 0.04, respectively. The CN for PTV2 were 0.59 ± 0.12, 0.58 ± 0.12 and 0.56 ± 0.12, respectively. The CN for PTV1 and PTV2 tended to become high using thinner MLC width. There are statistically significant differences in the CN for PTV1 and PTV2 (p < 0.05).

**Conclusions:** The planning goals set in the SIB-IMRT plan for localized prostate cancer were achieved by all the MLCs. However, a dosimetric advantage associated with smaller leaves was observed in terms of the conformity of the dose distribution.

Author Disclosure: E. Abe, None; T. Mizowaki, None; Y. Norihsa, None; Y. Narita, None; Y. Matsuo, None; M. Narabayashi, None; Y. Nagata, None; M. Hiraoka, None.

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**2912 Dose Calculation for Prostate Tumor using Human Anatomy-based Monte Carlo Algorithm Compared to CT-based Treatment Planning System**

Y. Liu, D. D. Nguyen, G. Swanson, T. Eng, N. Papanikolaou

University of Texas Health Science Center, San Antonio, TX

**Purpose/Objective(s):** The need for high accuracy dose calculation has long been an issue since the complexity of human body. In this work, we aim to build an accurate dose calculation algorithm based on human anatomy-based model and simulated by Monte Carlo code MCNPX. The Anatomy-based Monte Carlo dose for a prostate tumor was compared to a widely used TPS (Pinnacle3, 8.0d).

**Materials/Methods:** The human anatomy-based model was adapted from the sectioned images of human cadavers of the Visible Human Project from the National Library in Medicine. The sectioned images were digitalized to voxel-based volume arrays for
Composite Plans and Biological Effective Dose Distributions over Multi-modality/Multi-plan Radiotherapy for Plan Evaluation and Toxicity Risk Analysis

G. Zhang1, T. Huang2, C. Stevens1, E. Harris1, K. Lin1, K. Forster2

1Radiation Oncology, H Lee Moffitt Cancer Center, Tampa, FL, 2Department of Medical Radiological Technology, China Medical University, Taichung, Taiwan, 3Dept of Electrical Engineering, Chung-Yuan University, Chung Li, Taiwan

Purpose/Objective(s): With new radiation treatment technologies developing rapidly, cancer patients now have many choices of treatment modalities. Many patients undergo multi modalities for the same tumor site treatment. When different image sets are used in a patient’s radiotherapy treatment plans, the current commercial treatment planning systems have difficulty in generating composite plans. Some of the important dosimetric parameters, such as the overall tumor coverage, the volume irradiated of critical structures are thus difficult to obtain for the overall treatment evaluation. Due to the differences in dose rate, fractionation, treatment time, the biological effect of different treatment modalities is different. The composite plan alone would not provide a complete evaluation or toxicity risk analysis. This study introduces a method of generating composite plans and biological effective dose (BED) distributions over multi radiotherapy treatment modalities, or multi-stage plans using deformable image registration.

Materials/Methods: Two deformable image registration algorithms, thin-plate spline (TPS) and optical flow method (OFM) were used for the generation of composite plans and BED distributions from combinations of different treatment modalities, including external beam + radioactive seed implant, external beam + external beam, etc. The deformation matrices calculated from the image registration were used to map dose distributions from one plan to the other plan. The registered dose distributions were summed to be the composite plans. Registered individual plans were also converted to BED distributions. Contours were used to convert dose to BED for tumor volumes and normal tissues respectively. The composite BED distributions were generated by summing the registered individual BED distributions.

Results: The study included a case of prostate cancer with external beam IMRT and interstitial seed implant. A composite plan and a composite BED distribution were generated. The other case included in this study was a lung cancer IMRT treatment with two plans. Two trials were developed using anterior-posterior (AP)-PA and left-right (LR)-RL four beams treatment planning based on the Pinnacle3 and HAMD respectively. Isodose lines and dose profiles for each CT slice in the transverse, sagittal and coronal view of the VHP human model were provided by all of the two dose algorithm. Dose volume histogram and the mean dose in bladder, rectum and prostate tumor were compared between Pinnacle3 and HAMD.

Conclusions: Human-anatomy based Monte Carlo dose potentially provides a more accurate and more realistic dose distribution in human body. The significant difference in the prostate and rectum is dose between the two modalities needs to be investigated further. If verified, HAMD can offer basic benchmarking data for potentially simplified CT-based dose calculation.

Author Disclosure: Y. Liu, None; D.D. Nguyen, None; G. Swanson, None; T. Eng, None; N. Papanikolaou, None.