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Clinical Experience of ExacTrac to Guide Six Degree of Freedom Fiducial Marker Based Patient Positioning for Hypo-Prostate Fractionation

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Purpose: To compare the image guided registration errors (3D vs pseudo 6D) between the planning CT and the cone beam CT (CBCT) for intensity-modulated radiotherapy (IMRT) in nasopharyngeal carcinoma (NPC); and investigate the dosimetry differences between the two registration methods**. Methods:** A pseudo 6D registration could be performed without an 6D couch when only the translational shifts were applied. Firstly, a total of 40 NPC patients were collected with the same immobilization device to reduce the localization error in the radiotherapy. Secondly, Both planning CT and CBCT were registered online on the Linac console via 3D and 6D registration, respectively. Thirdly, two sets of positioning errors/shifts were obtained to explore the differences. Finally, the 3D error and pseudo-6D error plans were simulated and re-calculated via the Eclipse planning system to investigate the dosimetry differences, including both Target and OARs dosimetric values. **Results:** There was no statistically significant difference between 3D error and pseudo 6D set-up error, (P>0.05). In translational shifts, 3D set-up error （x±s）were ___ X:0.28±1.12 mm, Y:0.21±0.85 mm, Z:0.25±1.03 mm; and pseudo 6D set-up error （x±s）were ___ X:0.22±0.93 mm, Y:0.15±0.62 mm, Z:0.31±1.27 mm, respectively. There was also no significant difference between Conformity Index (CI) and Homogeneity Index (HI), respectively. Both Target and OAR were compiled the clinical requirements**. Conclusion:** In NPC image-guided intensity-modulated radiotherapy, the 6D rotation error had little effect on the change of 3D translation error, and there was no difference between the 3D and pseudo 6D set-up error plans in the target conformity index and uniformity index.

PO-GePV-M-134, Clinical Experience of ExacTrac to Guide Six Degree of Freedom Fiducial Marker Based Patient Positioning for Hypo-Prostate Fractionation: R Sandhu*, C Knill, B Loughery, L Lin, Z Seymour, Beaumont Health - Dearborn, Dearborn, MI

Purpose: ExacTrac is clinically used for inter- and intra- fraction shift corrections for hypofractionated prostate patients by registering to implanted fiducial markers. ExacTrac corrections for thirty-three prostate patients were collated and analyzed. **Methods:** ExacTrac shifts were exported for prostate patients (140 total fractions) who were treated with two 180° partial arcs with beam-on time less than 60seconds/arc. Prior to each treatment fraction, a cone beam computed tomography (CBCT) image was acquired to verify bladder and rectal filling against simulation. Following CBCT, ExacTrac was used for initial prostate localization and shifts were applied using a 6 degree-of-freedom (6D) couch. Following initial localization and in-between arcs, ExacTrac intra-fraction images were acquired and shifts were applied if prostate deviations were outside of 1.4mm/2° tolerance. Magnitude and direction of initial patient setup localization, intra-fraction corrections, frequency of re-starting patient positioning, and number of instances when patients were unable to be treated, were extracted from exported ExacTrac data**. Results:** The mean initial localization corrections in lateral, longitudinal, and vertical directions were -2.38mm (interquartile range: -5.16mm to -1.36mm), 1.96mm (interquartile range: -0.78 to 4.57mm), and -0.83mm (interquartile range: -4.50mm to 2.73mm) respectively. Mean initial rotations were less than 0.2° in all directions. However, 30% of lateral, 11% of longitudinal, and 8% of vertical initial rotations were greater than 2°. Following initial localization, 134 additional intra-fraction corrections were made. Patient positioning was restarted 22 times and daily treatment postponed 8 times due to inability to setup patients within tolerance or technical issues. Loosening shift tolerances to 2mm/2° would have decreased the number of intra-fraction shifts from 134 to 69**. Conclusion:** The ExacTrac 6D image guide system is a useful tool for daily setup for hypo-fractionated prostate patients. Further analysis is warranted to determine the dosimetric effect of current and potential loosened shift tolerances.

PO-GePV-M-136, Cranial Dose Calculation On Synthetic CT for Gamma Knife Radiosurgery: F Li[1]*, A Xu[2], O Dona Lemus[3], T Wang[4], M Sisti[5], C Wuu[6],(1) Columbia University, New York, NY, (2) Columbia University Medical Center, New York, NY, (3) University of Rochester, Rochester, NY, (4) Columbia University Medical Center, New York, NY, (5) Columbia University Medical Center, New York, NY, (6) Columbia Univ, New York, NY

Purpose: Gamma knife radiosurgery (GKS) cranial dose calculation using TMR 10 algorithm ignores tissue inhomogeneity which can introduce errors. Electron densities required for tissue inhomogeneity correction can be obtained from MRI based synthetic CT (sCT). The study estimates the dose differences as a result of tissue inhomogeneity with TMR10 and convolution algorithm (CA) on sCT**. Methods:** Post contrast T1-weighted (T1p) MRI based sCT were generated from two patients who underwent GKS, using cycle consistent generative adversarial networks. Twelve patients who underwent external beam radiotherapy and had T1p images were selected for training and one patient for testing. The training was evaluated with leave-one-out cross validation. Image intensities between patient CT (pCT) and sCT were analyzed with HU histogram comparison and mean absolute error (MAE). Three plans were designed with single 8mm shots at three different locations – near skull, near air cavities (sinuses) and near corpus callosum (homogeneous tissues). Shot times, indicative of dose differences, for TMR10 calculated on pCT and CA on sCT were compared with CA calculated on pCT**. Results:** For training assessment, the images were divided into two regions – bone (HU >300) and soft tissue (HU<300). The MAEs from bone and soft tissue is 445±86 HU and

