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Purpose/Objective(s): Fiducial marker seeds are routinely used for image guided radiation therapy (IGRT) to account for interfraction organ motion. A technique was developed to implant fiducial marker seeds into the pancreas for IGRT of unresectable tumors. We used fiducial marker seeds to quantitate the interfraction target movement in pancreatic cancer.

Materials/Methods: 18 patients with a histologically confirmed diagnosis of pancreatic cancer deemed unresectable underwent primary chemotherapy and radiation therapy between 5/2008 to 1/2010 with implanted fiducial marker seeds. Sterile marker seeds were implanted utilizing an ultrasound-guided endoscopic technique developed by the authors. Contouring was performed on a 3D conformal radiation therapy planning system and treatments delivered on an IGRT capable linear accelerator utilizing kilovoltage (kV) matched orthogonal images to verify target positioning. For the analysis, a consistent reference point on a vertebral body adjacent to the seeds was selected on these images. The distance on the right-left (X) axis, superior-inferior (Y) axis, and anterior-posterior (Z) axis were measured for each seed in relation to the selected reference point. Interfraction movement was calculated based on the difference between seed coordinates from the treatment plan and the seed coordinates on the kV orthogonal matched images.

Results: 49 seeds in 18 patients were implanted and were used for matched orthogonal IGRT. 122 fractions were analyzed for a total of 298 measurements. The mean interfraction shift was 4.9 mm (S.D.= 4.3 mm, range 0-21 mm) on X-axis, 6.8 mm (S.D.= 5.7 mm, range 0-32.4 mm) on Y-axis, and 4.8 mm (S.D.= 5.8 mm, range 0-44 mm) on Z-axis. The mean vector shift was 11.8 mm (S.D.= 7.6 mm, range 1-52 mm). Based upon this analysis, we estimate that without IGRT margins less than 5, 10, and 20 mm would result in geographical miss approximately 39%, 11%, and <1% of treatments respectively and that margins of approximately 10 mm would be necessary to keep geographical miss <10% of treatments.

Conclusions: The degree of organ movement can be quantified by analysis of endoscopically implanted fiducial marker seeds and the routine use of IGRT. Without IGRT, relatively large margins would be necessary to minimize geographical miss. The direction and magnitude of organ motion should be considered in treatment planning.

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