

Evaluation of five fiducial markers using MVCT and CBCT

Purpose: To evaluate different fiducial markers using different imaging modalities to find the optimal choices of markers.

Method and Materials: A pelvis phantom was constructed out of different plastics. Simulated prostate, femoral head, femur, and pubis bones are embedded in the phantom. The prostate has three removable plugs. These plugs are made to a tight press fit and can be removed. Plugs were machined that contained different fiducial markers. Two types of gold seed markers (both 1.2mm diameter), three types of coil markers (0.75 to 1.15mm diameter), and a carbon marker (1.0mm diameter) were evaluated. The phantom was scanned using conventional CT, Varian CBCT, and Tomotherapy MVCT with each of the different markers. For CBCT, two FOV settings were used. For MVCT, two different techniques were used. To help quantify the results, profiles through the markers were obtained. The maximum signal and FWHM were evaluated.

Results: The fiducial markers were clearly visible on all scans with the exception that the carbon marker was not visible using MVCT as expected. The smaller diameter coil had noticeably less artifact than the larger coils and the gold seed. The carbon marker had minimal if any artifact. Neither FOV for CBCT or technique for MVCT had a significant effect on marker visibility.

Conclusion: Given that the smaller coil had the least amount of artifact of the markers that were visible with all modalities it would seem to be an ideal choice for institutions that have multiple modalities. Smaller gold seeds may also have this property but were not included in this study. For institutions using only CBCT, the carbon marker would be the best choice.