AbstractID: 9358 Title: Comparison of the residual error in treatment set-up using different imaging techniques: A phantom study

Purpose: To assess the accuracy of three different imaging modalities (orthogonal pairs of 2D-kV or MV images and kV cone-beam CT (CBCT)) for image guided radiation therapy (IGRT) for four clinical treatment scenarios. **Method and Materials:** The accuracy of IGRT was investigated using four anatomical phantoms, each representing a specific clinical site and treatment set-up strategy. Bony alignment was used as a surrogate for tumour location and set-up accuracy for pelvic, head and neck and thorax phantoms, while implanted fiducials were the alignment target of a second pelvic phantom. Each phantom was subjected to the IGRT process currently used at this institution. For each imaging modality, the phantoms were set-up on the treatment couch and imaged. These images were aligned to the reference images and a couch translation was applied to correct for the set-up error. Verification images were then obtained to determine the residual error, which is an indication of IGRT accuracy. **Results:** All three image modalities resulted in a low average residual error (<1mm), with the residual error represented by the mean 3D displacement vector. The 3D CBCT resulted in the lowest overall residual error (0.35mm) as compared to the 2D MV imaging (0.7mm) and 2D kV imaging (0.5mm). This advantage, however, is site specific, and the use of volumetric imaging had the largest impact on IGRT strategies relying on bony alignment to the skull or thorax. For example, the volumetric information helped reduce the residual error to 0.24mm for the skull, compared to 1.04 and 0.63mm for the MV and kV portal imaging based techniques, respectively. **Conclusion:** CBCT imaging provided the lowest residual error for set-up correction, but the magnitude of the advantage was site-specific. More sophisticated or clinically time-consuming techniques would be best suited to treatment sites for which they would provide the most benefit.