Purpose: Stereotactic radiotherapy delivers large doses of radiation to small volumes with steep dose gradients, and therefore requires accurate positioning and near complete immobilization throughout the delivery of treatment. This work assesses intra and interfraction patient motion for two immobilization devices for patients treated on Tomotherapy.

Methods: The study set consisted of 60 patients undergoing treatment for brain metastases over 5 fractions on MVCT imaged-guided Tomotherapy. Patients were immobilized using either the frameless Aktina PinPoint system or thermoplastic mask with bite block. To assess intrafraction motion, a scan was performed at the end of 2 treatment fractions. All MVCT Tomotherapy images were registered to the original kVCT in Amira 5.2 using a quasi-newton, normalized mutual information affine transformation. To assess the precision and accuracy of MVCT image acquisition, reconstruction and off-line Amira registration to kVCT, a phantom study was conducted.

Results: The phantom study demonstrated that the total error (noise floor) of the measurements and imaging/registration workflow was 0.11 Â± 0.09 mm. The Aktina frameless immobilization device yielded an average displacement of 2.58 Â± 2.29 mm for intrafraction patient motion and 2.54 Â± 1.37 mm for interfraction patient setup differences, while mask immobilization yielded average intrafraction patient motion of 1.29 Â± 1.18 mm and interfraction patient setup differences of 2.13 Â± 1.49 mm. Finally, 95% of all intrafraction motion using mask immobilization fell within our clinically used 2 mm margin, as compared to 75% of Aktina immobilization over the same margin. A margin of 3.5 mm is necessary for Aktina immobilized patients to include 95% of intrafraction motion within the margin.

Conclusions: Our data indicates that mask immobilization performed better at preventing intrafraction motion and reducing interfraction patient setup differences.