Purpose/Objective(s): Current methods of adaptive radiation therapy rely on serial imaging, which creates a segmentation and image analysis workload for the physician. We have created an automated process utilizing real-time electromagnetic tracking data to evaluate the adequacy of PTV margins in prostate cancer, allowing for a ‘physician-less’ process of adaptive radiation therapy. We present an analysis of PTV adequacy, and a validation of our adaptive process.

Materials/Methods: Tracking data was analyzed for 15 patients who underwent SMLC IMRT with uniform 5mm margins for prostate cancer utilizing the Calypso® 4D Localization System between 11/2007 and 3/2009. Treatment was delivered only if reported setup rotation was less than 10° and while isocenter displacement was less than 3 mm during real-time tracking, to prevent radiation delivery during large anatomical variations. Additional plans were generated with 0 and 3 mm PTV margins. A custom software application that convolved the original dose distribution and structure location from simulation with the over 50,000 measured translations and rotations for each patient’s course of therapy was developed in Matlab. The dose delivered to the prostate was then calculated for the first 10 fractions, and for the entire treatment. A treatment course was considered adequate if the minimum delivered dose to the prostate \(D_{\text{min}}\) was at least 98% of the planned \(D_{\text{min}}\).

Results: For 0, 3, and 5 mm PTV margins, adequate treatment was obtained in 3/15, 12/15, and 15/15 patients, and the delivered \(D_{\text{min}}\) ranged from 78-99, 96-100, and 99-100 percent of the planned \(D_{\text{min}}\). While the degree of translational and rotational motion varied widely among patients, adequacy of treatment during the first 10 fractions predicted sufficient dose delivery for the entire treatment for all patients and margins. For the 15 cases of inadequate treatment delivery, early analysis after the first 10 fractions revealed the need for PTV expansion thereby validating the adaptive process.

Conclusions: Our adaptive process successfully utilized real time electromagnetic tracking data to predict the need for PTV modifications, without the added burden of physician contouring and image analysis. While applied here to standard fractionation prostate cancer treatment, our dose verification methods are readily applicable to hypofractionated treatment, and other instances in which real time tracking is utilized.

Author Disclosure: J.R. Olsen, None; C. Noel, None; K. Baker, None; L. Santanam, None; J. Michalski, None; P.J. Parikh, Calypso Medical Systems, B. Research Grant.