

Purpose: Total marrow irradiation (TMI) delivered via helical TomoTherapy (HT) presents a unique challenge for organ localization because the entire target structure (skeletal bone) cannot be imaged and registered with the planning CT accordingly. Therefore a few surrogates must be used to determine the position of many structures along the entire length of the patient. We investigated the CTV to PTV margin sizes required in order to maintain common target coverage requirements.

Methods: Three patients were immobilized in full-body Vac-locs with a thermoplastic mask to cover the head and shoulders. Patients were initially aligned to the head and neck anatomy and to the pelvic girdle in upper body and lower body plans, respectively. Both plans were interrupted during delivery to determine the position of different anatomy (the T10 vertebrae in the upper body plan and the ankle region in the lower body plan) and to realign the patient.

Results: Intrafraction motion in the S/I direction was within the uncertainty of the measurement. The positions of the same anatomy separated by up to 40 min correlate well ($R > 0.8$) indicating that intrafraction motion is small. The standard deviations of the systematic setup errors were all under 2mm, and were marginally smaller in the upper body plan. The standard deviations of the random setup errors were twice as large in the L/R directions than in the A/P directions for both the upper and lower body plans. We determined the width of the blurred dose distribution penumbra specific to the interrupt locations.

Conclusions: The resultant margins in the A/P directions and L/R directions were similar in both plans, under 8mm. The data presented only applies to the limited number of patients and interrupt positions chosen, and requires further investigation at many different anatomical sites in order to be applied over the whole body.