

Purpose: Spinal SBRT was originally developed for the retreatment of patients with disease progression. However, the indication has evolved to the up-front treatment of spinal metastases with the intent to maximize the biological effective dose and improve local control, while sparing the adjacent spinal cord. We report on the stability of our technical approach of performing single-fraction (18-24Gy) SBRT for spinal metastases using the Elekta Synergy-S and BodyFIX immobilization systems. We evaluate the residual set-up error and intra-fraction motion using cone-beam CT (CBCT).

Methods: Analysis is based on 20 consecutive patients (93 image registrations) with spinal metastases treated with single-fraction SBRT. Following initial set-up, a CBCT was acquired to align the patient and a pre-treatment CBCT was taken to verify the alignment and determine the residual set-up error. Two intra-fraction CBCT images were used to assess immobilization and correct any misalignment exceeding 1mm or 1°, in all six degrees-of-freedom using the HexaPOD robotic couch. A post-treatment CBCT was used to verify immobilization for the entire treatment, but it was not acquired for 7 of the patients due to the time restriction of the BodyFIX immobilization.

Results: Most positioning errors after the initial CBCT setup were relatively small, with 95% of the image registrations within 1mm and 99% within 1°. Although a higher frequency of misalignments was observed in the lateral direction (8 of the 13 translations exceeding 1mm; 2 of the 4 rotations exceeding 1°), there was no significant difference between the directions. The absolute intra-fraction motion averaged over all patients and directions (\pm stdev.) was 0.4 (\pm 0.5) mm for the translations and 0.3 (\pm 0.4) degrees for the rotations.

Conclusions: Near-rigid immobilization with the acquisition of two intra-fraction CBCT images and the correction of misalignments in all six degrees-of-freedom provides the necessary precision to safely perform single-fraction SBRT of spinal metastases.