The goal was to compare the residual setup errors measured with ExacTrac X-Ray six degree-of-freedom (6D) monitoring system and kilovoltage cone-beam computed tomography (CBCT) in patients receiving stereotactic body radiotherapy (SBRT). The first device performs pre-positioning using an infrared optical system based on body markers, while a X-Ray imaging system carries out target verification using internal anatomy. On the other hand, CBCT, through the acquisition of a patient’s 3D image, allows for positioning control using both bone anatomy and soft tissue.

On a TrueBeam-Novals treatment unit, from January 2017 to July 2018, 93 patients with extracranial tumors were submitted to image-guided (IG)-SBRT for a total of 113 lesions and 343 treatment sessions. For 85 of these patients (311 treatment sessions), the 6D image registrations on infrared X-Ray monitoring system were performed together with CBCT. Planning techniques were dynamic conformal arc therapy or hybrid intensity modulated radiotherapy (HybridArc, BrainLab) with non-coplanar fields, or volumetric modulated arc therapy. All patients were initially located using personalized immobilization systems. Setup corrections were determined and corrected by means of registrations of ExacTrac X-Ray images with the corresponding digitally reconstructed radiographs using the ExacTrac 6D-fusion algorithm.

At the end of each treatment session, with the couch at 0°, the residual setup error was determined by means of registrations of CBCT images with the planning CT using online 3D fusion; for each session, to analyze the residual setup errors, displacements were evaluated.

The average residual error differences (absolute values) between CBCT and ExacTrac image registrations were 1.28 ± 1.19 mm, 1.31 ± 1.28 mm and 1.14 ± 1.12 mm in the vertical, longitudinal and lateral directions, respectively.

Our study showed a good agreement on the setup accuracy and image registration between ExacTrac X-Ray 6D monitoring system and CBCT for patients receiving SBRT. The two IGRT systems presented similar precision. Nevertheless, the in-room X-Ray based monitoring system offers additional benefits in terms of capability to quantify all rotational errors, fastest automated positioning in 6D even for non-coplanar fields and smaller doses. Thus, BrainLab ExacTrac X-Ray represents a valid alternative to CBCT offering complementary information in IG-SBRT.