The purpose of this study was to analyze patient skin motion data collected during CyberKnife® stereotactic radiosurgery. The CyberKnife is a radiation treatment system that incorporates a linear accelerator mounted on a robotic arm. Fiducials inserted before the procedure are used to track tumor location using two orthogonal x-ray cameras. The system can automatically compensate for translations up to 10 mm.

The Polaris infrared tracking system (Northern Digital, Ontario, Canada) was used for recording skin motion. The positions of 3-4 skin markers placed on the patient’s abdomen were recorded by the Polaris, which was placed on a tripod at the foot of the patient couch. The internal fiducial position was extracted from log files recorded by the CyberKnife system. We took data on eight spine patients undergoing CyberKnife treatment. The movement amplitude of the skin markers ranged from 3.1 mm to 14.8 mm with a median of 7.5 mm. The average movement of the skin marker centroid was between 2.6 mm and 6.0 mm. The data was analyzed for breathing patterns using a FFT. The maximum power occurred at frequencies between 15 Hz and 23 Hz.

This study serves as a first step towards our long-term goal of using skin motion to predict internal organ motion. This may lead to more precise radiation treatment delivery for mobile target volumes.