

## **Evaluation of a Passive Infrared Marker System for Radiotherapy Patient Positioning**

We have evaluated a passive IR system as an alternative to conventional methods of patient positioning. Because positioning of the target at the isocenter depends on marker shift, we first used the system to measure the movement of markers due to breathing. As expected, bony areas only move about 1 mm. Shallow breathing limits movement of the chest area between 2 to 5 mm. Even large movements of some markers, however, displace the calculated target position by only 1 to 3 mm. Between successive exhales, the markers return within 1 mm of their original positions and the target shifts by only 0.5 mm. Positioning during exhalation thus improves accuracy. A vacuum couch that rigidly holds the initial position of the patient results in further improvement. Under these conditions, the markers shift less than 2 mm on the skin between reattachments. Reattaching the markers several times on the same day displaces the target by 2 mm on the rib and 1.5 mm on the pelvis. Attaching the markers over several days worsens these values by 0.5 mm. Four markers increase the displacement to over 2 mm. Six markers also worsen displacement if the sixth marker attaches to a location that moves considerably. In conclusion, positioning during exhalation and rigidly supporting the patient allow the system to consistently reposition a target on a living subject within 2 mm of its initial position.